February, 1958

The Mining Magazine

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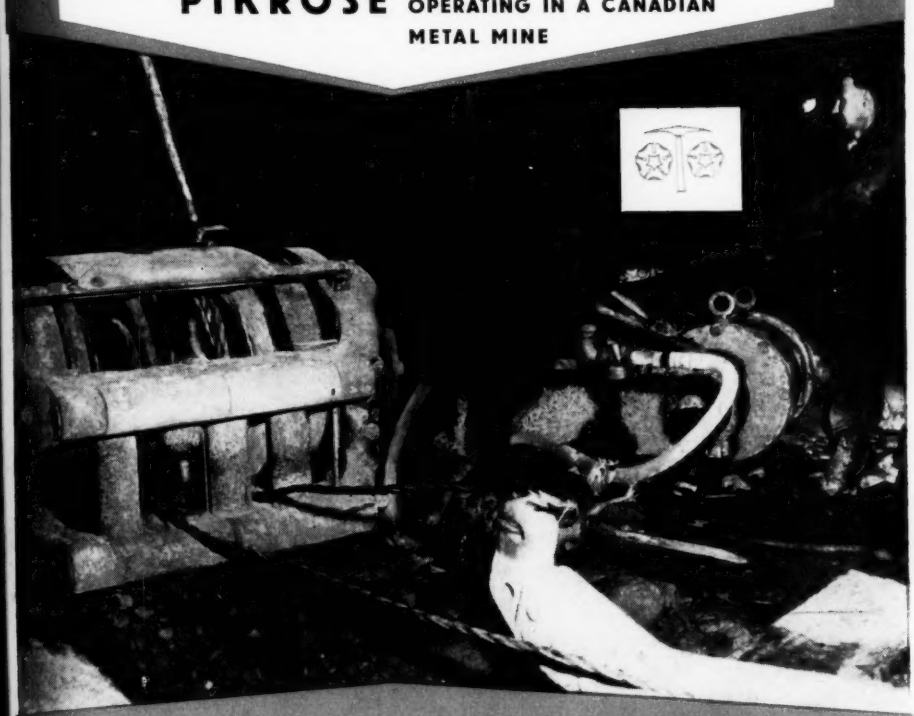

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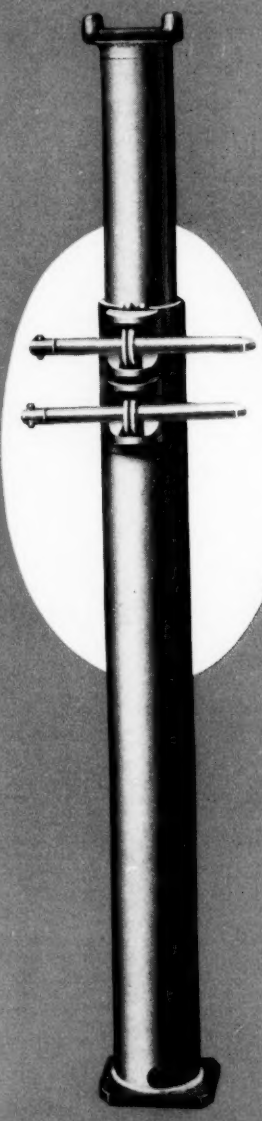

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EDITORIAL

IT has been announced that, implementing the decision made known in Stockholm, the Institution of Mining and Metallurgy is to hold an International Congress on Mineral Processing in London from April 6 to 9, 1960. It is proposed that the papers to be discussed should cover fundamental and applied research and development in the fields of mineral dressing, chemical processing, roasting, cyanidation, leaching, and solvent extraction, but not smelting.

IN the three days April 14 to 16 next the Midland Counties Institution of Engineers is to hold a symposium at the University of Nottingham on power loading. Accommodation for approximately 200 delegates has been provisionally reserved, while advance copies of all papers to be presented are to be circulated to registered members about two weeks in advance. Applications should be made to the Honorary Secretary, c/o No. 6 Area Headquarters, National Coal Board, Bestwood, Nottingham.

RECENT successes in the continued search for oil in the United Kingdom have been reported by the BP Exploration Company. At Langar and Bothamsall, in Nottinghamshire, initial test-wells have found oil, although further drilling will be needed to determine the extent of the discoveries. First results raise hopes that they indicate new oil deposits of commercial significance. Both the Langar and Bothamsall wells are relatively near existing oilfields it is stated, Langar being some three miles west of Plungar, discovered in 1953, and Bothamsall five miles north-west of Egmanton, discovered in 1955. The total production of crude oil in 1957 from existing BP oilfields in this country—Eakring and Egmanton (Notts.), Plungar (Leics.), and Formby (Lancs.)—amounted to some 82,000 tons.

THE Australian Bureau of Mineral Resources has recently announced what is considered to be an advance in aerial prospecting methods. While it has been standard practice for some time to carry a scintillograph in the survey aircraft the new scheme involves the use of two such instruments, one fitted in the cabin of the aircraft and the other towed on a cable some 200 ft. below. The use of the additional detector has been found to give several important advantages, since it assists greatly in distinguishing between broad areas of weak and insignificant radioactivity and small areas of high radioactivity which may be of economic importance. Another important advantage, it is considered, is that it gives simultaneous recording of the radioactivity at two different levels. Theoretical investigations by officers of the Bureau and test flights at different heights over known radioactive deposits in the Cloncurry–Mount Isa region have shown that simultaneous records from two levels make it possible to obtain an estimate of the grade of the surface radioactive deposit. Successful test flights with the new equipment were completed over Port Phillip Bay, Victoria, and the first survey, using the new technique, is at present in progress in the Broken Hill area.

LATER on this month the Institute of Quarrying is to hold its third " Short Course on Quarry Practice " in Leamington. For the occasion " A Review of Exploration Methods for Naturally-Occurring Raw Materials, with Particular Reference to Geophysics and Drilling " has been prepared by G. Vann, H. A. Hetherington, and H. Sasson. In considering the effective use of scientific exploration methods at minimum cost it is stressed that clear definition of the object of exploration, sound planning, and control of programme, including the choice of methods and correct co-ordination and interpretation of results, are factors of the utmost importance. Experience gained in other fields, particularly in the oil industry, can often be applied to mining problems, it is pointed out, and attention is drawn to the wide variety of geophysical techniques and drilling methods available. The principles governing the application of seismic, magnetic, gravity, electrical, and radioactive geophysical methods are briefly described and their

potentialities and limitations outlined, with particular reference to the needs of mining and quarrying. The paper highlights the importance of basing all exploration procedures on a sound appreciation of the prevailing geological conditions and underlines the necessity for clear expression of the results of exploration in terms readily understandable to those concerned with development and production. The paper also covers basic types of prospecting drilling equipment and reviews factors which govern the choice of drilling method, including depth and diameter of hole, type of samples required, potential core recovery, etc.

New Source of Thorium

Reference was made in the January issue [1] to the formation of a new company by the Rio Tinto Mining Co. of Canada, Ltd., and Dow Chemical of Canada, Ltd., whose initial purpose will be to concentrate on the production of thorium and rare-earths from by-product materials produced by the three mining companies in the Elliot Lake area of Canada managed by the Rio Tinto group. The new company—Rio Tinto–Dow, Ltd.—is also to undertake metallurgical research in the same connexion.

It will be recalled that in an article on "The Economic Geology of Thorium" by Professor C. F. Davidson, which appeared in the MAGAZINE for April, 1956, it was reported that the greatest potential source of low-cost thorium in the world existed in waste liquors being produced in the Blind River uranium field. The ore contains upwards of a third as much thorium as it does uranium. Since the cost of mining, reduction, and leaching is borne by the uranium the waste liquors from the uranium recovery process, containing the bulk of the thorium, represent a source from which the latter element is potentially available at relatively little expense.

The entry into this novel field by the Dow Chemical Company, an organization already renowned for its researches on synthetic resins, is particularly apt, since the article referred to forecast that "assuming an adequate demand arises, the successful output of by-product thorium from these Canadian plants will probably be dependent on the evolution of an ion-exchange resin specific to thorium, similar to the resins being utilized for the extraction of uranium."

[1] p. 7.

Future for U.K. Coal

At the annual meeting of the Institution of Mining Engineers held in London last month the new president, Mr. H. A. Longden, chose in his presidential address to talk of "Coal Mining in the Nuclear Age." Far from being pessimistic regarding the future demand Mr. Longden suggested that coal, for centuries the main source of power and heat in this country, had every prospect of continuing to be so for many years to come in spite of competition. While the demand for power for industry continued to grow, as the nation strives to survive as an industrial country and at the same time steadily to raise its standard of living, neither oil nor nuclear fuels are likely yet to displace coal as the chief source of power. In the next 20 years, the president said, additional power requirements have been estimated to need an equivalent of 5,000,000 to 6,000,000 tons of coal, of which nuclear energy may supply one-fifth in the first decade and still only a half of the increase in the second decade. Thus, in 1975, energy requirements may total 370,000,000 tons of coal equivalent, of which 80,000,000 tons may be provided by oil and 40,000,000 tons by nuclear plant, leaving coal with the lion's share of 250,000,000 tons—a figure, incidentally, which is some 40,000,000 tons higher than the current level of deep-mined output. Such figures, Mr. Longden said, put the relative positions of the three sources of power in their true perspective, although in the long run it would be a question of economics which would determine the extent to which nuclear energy may replace coal, while competition from oil might depend more on availability than on economics. At the same time certain coals other than the pure burning types would remain steadily in demand, in particular the coking coals. The demand for steel, the speaker said, would increase as living standards rose and coking coals would be increasingly needed. Indeed it might be necessary to apply a degree of conservation by an increased use of blending to utilize such coals to the best advantage.

Naturally Mr. Longden foresees a steady increase in the application of machinery to mining, "culminating," he thought, "in

almost complete mechanization" of all operations. This process would, of course, be accompanied by increased dirtiness and decreased product size, although the extension of modern coal-preparation facilities would produce qualities of coal in the smaller sizes quite as satisfactory as the larger coal of the past. New machines, new plant, new equipment would, of necessity, be adopted by consumers, both domestic and industrial, to get maximum efficiency from a valuable commodity, to utilize the smaller grades to best advantage, and to banish smoke from our cities. At the same time the industry itself would require more well-trained operators, mechanics, and electricians and fewer men with picks and shovels. The supervisory ratio would rise to meet the demand for ever-increasing efficiency in planning and operation and in giving guidance and advice on the training of such men. It is, however, he said, vital for the future of the industry and still more for the future of the country, to produce coal more cheaply than alternative forms of power. Coal is the life-blood and, as in the past, prosperity as a nation would depend on it for very many years to come.

Record United States Output

The usual preliminary report issued by the United States Bureau of Mines shows that the mineral output in that country during 1957 reached a new record at $18,300,000,000, a gain of $750,000,000 over the figure for the previous year. The increase reported was due almost entirely, it is stated, to higher values for the mineral fuels, particularly crude oil and natural gas, which were large enough to offset declines in production for most other minerals, as well as sharp drops in base-metal prices. Natural gas and iron ore were the only major commodities to show sizeable production increases. While anthracite, cement, gypsum, phosphate rock, bauxite, chromite, and tungsten all declined in both production and value, helium, barite, diatomite, cobalt, mercury, ilmenite, and uranium ore all registered substantial production and value gains. The value of the gold output, estimated at $62,000,000, was the lowest since 1945, but the values of uranium-ore production, estimated by the Bureau at nearly $75,000,000 in 1957 and $63,000,000 in 1956, are now included in the totals for the first time. The report records that the year was extraordinary for many mineral-producing industries. The Suez Canal closure crisis extended well into 1957 and contributed to a major dislocation in petroleum production, transportation, and inventory patterns, while reduction in stockpile purchases, declining consumer demand, and a lessening of agricultural barter transactions combined to force lead and zinc prices downward. At the same time copper prices continued to fall from the 90-year record of 46 cents a lb. in February, 1956, to 32 cents only a year later and to 27 cents by September, 1957.

Particularly interesting are the first returns for uranium. It is recorded that the production of domestic uranium concentrate was in 1957 at the rate of nearly 10,000 tons of uranium oxide a year, as compared with about 6,000 tons in 1956, and this is expected to rise to 15,000 tons or more in 1959. The "free-world" production in 1957 was estimated at about 21,000 tons of uranium oxide. Fourteen uranium mills with an aggregate capacity of 10,000 tons of ore a day were in production in the United States at the end of the year. At least five of these employed solvent extraction and four mills currently proposed or under construction are expected to utilize the method developed by the Bureau. The Atomic Energy Commission announced in October that uranium deliveries under its procurement programme appeared adequate for military and power requirements for the next several years. The immediate object is to keep production and requirements in reasonable balance, but the long-range problem is to develop additional ore reserves for future requirements. At least 10 nuclear-power reactors and 39 research and test reactors were operating in the United States in 1957. In addition 123 power or research reactors were being constructed or had been contracted for by American firms, some for installation overseas. The first non-military reactor to produce electric power for commercial distribution in the United States was completed and two nuclear-powered submarines were in operation. About 130,000 lb. of U235—the fissionable isotope of uranium—was made available for peaceful uses, bringing the total for 1956–57 to 220,000 lb., valued at $1,700,000,000. The United States exported about 37·5 kg. (about 80 lb.) of U235 in 1957, principally in the form of fuel elements for research reactors.

MONTHLY REVIEW

Introduction.—While the pound sterling remains firm commodity markets continue to weaken, reflecting uncertainty as to the ability of industry in the United States to weather the present recession. Cuts in output by the leading base-metal producers are helping to sustain prices at about the levels current over the past month.

Transvaal.—The output of the gold mines of the Rand and Orange Free State for December was returned as 1,366,354 oz., making with 35,789 from outside mines a total of 1,402,143 for the month. Corresponding figures for January are 1,377,505 oz., 40,534 oz., and 1,418,039 oz. At the end of December there were 299,137 natives at work in the gold mines, a figure which had risen to 314,239 at the end of January.

The total estimated working profit for the December quarter of the mines which are members of the Transvaal and Orange Free State Chamber of Mines has been announced as £23,695,380, of which £8,933,430 is attributed to uranium.

At an extraordinary meeting of NEW MODDERFONTEIN GOLD MINING held in Johannesburg on February 7 shareholders were asked to approve an agreement for the sale of the company's property and its remaining assets. The consideration is £100,000.

In his statement to shareholders at the annual meeting of RUSTENBURG PLATINUM MINES held last month at Johannesburg the chairman said that the level of sales for the current year was about 50% of the figure for the previous financial year and in order to align production to this level of sales a further reduction in the scale of operations is to be made. Milling at the Union section will be reduced to negligible proportions. The Rustenburg section could, if desired, produce sufficient platinum to meet sales at the 1957 level and during the balance of the current year it may be possible to reduce the present level of stocks.

In the three months to December 31 last, MESSINA (TRANSVAAL) DEVELOPMENT produced 243,487 tons of ore containing 3,470 tons of recoverable copper.

A circular to shareholders of TATI GOLDFIELDS issued last month states that an agreement has been signed with " a leading mining house " in South Africa, as a result of which Tati will be refunded all costs and expenses in obtaining its farms, *plus* option money already paid. The properties are to be drilled and proved and if a company is formed to work the ground the Tati company will receive royalties on coal sold, as well as a 10% subscription right and 10% underwriting rights in any company formed to mine the area.

The ROOIBERG MINERALS DEVELOPMENT COMPANY reports a working profit of £16,235 for the December quarter. In the period 274 long tons of tin concentrates was produced.

An extraordinary meeting of the WELGEDACHT EXPLORATION COMPANY held in Johannesburg last month approved the agreement with UTRECHT COLLIERIES for the purchase of its undertaking as a going concern. In reply to questions by shareholders at the meeting the chairman stated that the estimated life of the colliery was about ten years, but further exploratory work would be conducted.

With the recent dividend notices shareholders of the ANGLO AMERICAN INVESTMENT TRUST and WEST RAND INVESTMENT TRUST were informed that the estimated profits for 1957, after providing for taxation, are £3,051,500 and £1,715,000, respectively.

Orange Free State.—At the annual meeting of FREE STATE GEDULD MINES held last month shareholders were informed that since the end of the December quarter development results have improved. At No. 1 shaft 235 ft. were sampled up to January 24, 85·1% proving payable at an average value of 1,224 in.-dwt. At No. 2 shaft 620 ft. were sampled during the same period, 100% proving payable at an average value of 1,814 in.-dwt. The average values for the mine up to the same date, taking both shaft areas into account, were 1,670 in.-dwt.

It has been stated that with the introduction of surface waste sorting at PRESIDENT STEYN GOLD MINING it has been possible to stope a limited amount on the Leader Reef, which has a high uranium content, with a consequent benefit to uranium recovery and without unduly affecting the average gold content per ton milled.

At WELKOM GOLD MINING, it is an-

nounced, preparations are being made for sinking the 12 ft. diameter vertical ventilation winze, sited to the west of No. 1 shaft, where drilling for pre-cementation purposes is now complete. This will be sunk to a depth of approximately 1,600 ft. and is expected to be complete by the end of the current financial year. It will provide additional ventilation capacity to improve underground conditions in the area of No. 1 shaft.

With the recent dividend notice shareholders of the ORANGE FREE STATE INVESTMENT TRUST were informed that the profit for 1957, subject to final audit, is £1,399,000, after providing for taxation.

Northern Rhodesia.—As a means of reducing the output of copper, it was announced last month, the RHOKANA CORPORATION and NCHANGA CONSOLIDATED COPPER MINES have proposed to BANCROFT MINES that it should cease production of copper temporarily and confine its operations to the continuation of primary underground development and pumping at No. 1 shaft, which will put the mine in a position to resume production at short notice at its full capacity, at considerably lower production costs than can be obtained at present, when the copper market returns to normal. Bancroft production was expected to be at the rate of 40,000 tons a year. In consideration of Bancroft agreeing to cease production for a year Rhokana and Nchanga have offered to pay a sum sufficient to cover interest on loans and the continuation of the primary development and pumping at No. 1 shaft for this period. The directors of Bancroft have accepted the offer.

In the six months to December 31 last MUFULIRA COPPER MINES produced 47,052 tons of copper and CHIBULUMA MINES 10,501. The estimated profit of the two companies for the period are given as £2,160,000 and £585,000 respectively. Similar figures for ROAN ANTELOPE COPPER MINES show 38,793 tons of copper produced in the six months and an estimated profit of £1,155,000.

Gold Coast.—A circular to shareholders of the CONSOLIDATED AFRICAN SELECTION TRUST last month stated that arrangements have been completed which enable the company and its wholly-owned subsidiary company (SIERRA LEONE SELECTION TRUST) to qualify as Overseas Trade Corporations and notice has been received from the Board of Inland Revenue that both companies are potentially regarded as such with effect from January 1, 1958. This will result in a reduction in the companies' liability to United Kingdom tax and it is expected that a future saving will arise annually. In future dividends paid by Consolidated African Selection are to be apportioned between trading profits and non-trading profits. That part of the dividends which is paid out of trading profits will no longer be regarded as investment income for profits tax purposes.

Nigeria.—The mineral output of Nigeria for December, 1957, included 928 tons of cassiterite, 117 tons of columbite and tantalite, and 24 tons of thorite.

The report of the NIGERIAN COAL CORPORATION for the year ended March 31, 1957, shows that the year's working produced a surplus of £57,623, which reduced the total accumulated loss to date to £278,395. Although there was some increase in the costs of production the level of output was sufficient to absorb the additional charges, it is stated. The total output from the three mines operated by the Corporation amounted to 790,030 tons, an increase of 39,972 tons over the figure for the previous year. It is also stated that work is going vigorously ahead on the new Ekulu mine, which is planned to go into full operation in 1960. The main access road has been completed and at the beginning of May, 1956, a start was made on the two main drives planned to develop the area.

Tanganyika.—In the December quarter URUWIRA MINERALS mined 75,299 metric tons of ore and produced 3,667 tons of concentrates assaying 45·87% lead and 10·93% copper, with 1,498 g. per ton silver and 24·14 g. per ton gold.

Australia.—At an extraordinary meeting of the GOLD FIELDS AUSTRALIAN DEVELOPMENT COMPANY to be held in London later this month it is to be proposed that the capital of the company be reduced to £400,000 by a return of 1s. on the issued 3s. shares. Upon the capital reduction taking effect it is proposed to increase it once again to £500,000 by the creation of 400,000 new 5s. shares.

Shareholders of MOUNT MORGAN, LTD., were informed last month that in May and June, 1957, the Australian Tariff Board investigated the question of what assistance, if any, should be accorded the production of copper in the Commonwealth and in November and December, 1957, inquired into the Sulphuric Acid Bounty Act. Neither of the reports on these inquiries has been published, it is stated, but the directors deem it prudent

to defer consideration of an interim ordinary dividend until they have and until the decisions of the Commonwealth Government in regard to them are known.

New Guinea.—In the six months to November 30 last BULOLO GOLD DREDGING treated 3,075,400 cu. yd. of ground and recovered 17,315 oz. of gold. In the period only one dredge (No. 5) was operating.

Malaya.—RAMBUTAN, LTD., reports a profit of £19,014 for the year to June 30 last, the accounts showing £50,714 available, of which dividends equal to 4s. a share require £11,500. In the year 402,076 cu. yd. of ground was treated and 173 tons of tin ore recovered.

The report of SEREMBAN, LTD., for the year ended June 30 last shows a loss of £2,794. The chairman in his statement to members says that, owing to continued unfavourable security conditions prevailing in the area, mining operations were again only carried out spasmodically during the year under review and 13·97 piculs of tin ore were produced.

With the recent dividend notice shareholders of TEKKA-TAIPING, LTD., were informed that it had been agreed to dispose of the mining lease for part of the company's mining area not considered economically workable by their own dredge for £40,000. The matter is subject to completion of contract.

India.—In the three months to December 31 last the INDIAN COPPER CORPORATION treated 113,386 short tons of ore and produced 2,062 long tons of refined copper.

Brazil.—Shareholders of the ST. JOHN D'EL REY MINING COMPANY were informed last month that recent discussions in Brazil led to the appointment of a Government Commission to study the problem of the gold-mining industry in Brazil with a view to finding a solution calculated to relieve the company of its present economic and financial difficulties, such difficulties having been caused by substantial wage increases imposed by law in August, 1956, and the international fixed price for gold. A cable received on January 20 from the general manager at the company's properties in Brazil stated: "Commission report delivered SUMOC Friday. Understand Commission have recommended application emergency formula as from November for 6 months based on cost of production plus allowance £60,000 per annum for depreciation but amortization Banco do Brasil debt excluded. Hope to obtain SUMOC approval this week." Stockholders are to be immediately advised when full details are available. It was also stated a communication had been received from New York stating that Mr. Leo Model had granted the M.A. Hanna Company an option on a substantial percentage of his holdings in the St. John d'el Rey Company. The M. A. Hanna Company is already a substantial stockholder in the company and suspended earlier negotiations with the company in January, 1957.

Canada.—It was announced last month that CAMP BIRD, LTD., and BRIVAN MINERALS, LTD., of Toronto, have entered into a joint venture in the field of airborne prospecting for minerals in North America. This is to have the exclusive use of the new, miniaturized "Flying Prospector" electro magnetic-galvanic equipment devised by Mr. Bjarni Bjarnason. It is stated that actual prospecting began in Canada several weeks ago, while ground exploration has already been started on interesting anomalies shown in the first airborne surveys. Intensive work is to be carried out for the next 12 months in a continuous exploration of interesting geological areas in North America. British Treasury permission has been granted to Camp Bird to expend $300,000 on this work. Camp Bird is to open a headquarters in Toronto to cover this aspect of their mining operations and plans to extend this headquarters to cover its industrial and financial branches as well.

Mexico.—The accounts of SAN FRANCISCO MINES OF MEXICO for the year ended September 30 last show a profit of £569,329 and £1,191,579 available for appropriation, of which dividends equal to 4s. 6d. a stock unit require £537,200. In the year a record tonnage of 796,100 was milled, 53,511 tons of lead concentrates, 7,546 tons of copper concentrates, and 89,744 tons of zinc concentrates being produced. Ore reserves at September 30 last are estimated at 5,077,460 metric tons, of which 3,530,580 tons are fully blocked out. In his statement accompanying the report and accounts the chairman says that development on the recently-discovered veins near the North shaft of the Frisco mine continued to give satisfactory results during the year, while ore reserves were maintained and are sufficient to supply the mill at full capacity for more than six years. Moreover, he says, reserves of broken ore were materially increased to a level which amply provides for production at the present rate.

In the three months to December 31 last

the FRESNILLO COMPANY milled 230,587 short tons of ore and recovered 15,858 tons of lead concentrates, 18,599 tons of zinc concentrates, and 936 tons of copper concentrates.

Cyprus.—In a progress report issued earlier this month shareholders of ESPERANZA COPPER AND SULPHUR are informed that the Limni plant of CYPRUS COPPER AND SULPHUR has been rehabilitated and modified to treat current and future mine output with resultant products suitable for ready sale. The installation of all the requisite leaching plant and equipment is practically completed and it is hoped that as soon as a special pump unit, now en route to Cyprus, is installed, production of cement copper will begin. In addition over 30,000 tons of cupreous pyrite are already in stock at the jetty towards the contract quantity of 50,000 tons to be delivered this year. It is planned to pass some 60,000 tons of cupreous pyrite ore *ex* Kinousa opencast ("Uncle Charles") through the flotation plant of the Limni mill. This operation should yield some 7,500 tons of good-grade concentrates in 1958 and a contract for sale is being negotiated at the present time. Plans are also laid for a further tonnage of copper-gold-silver concentrate to be produced in 1958 and 1959 from the treatment of some 45,000 tons of sands and slimes *ex* Kinousa mill and further profit may accrue from the sale of these concentrates.

Consolidated Gold Fields of South Africa, Ltd.—In a note last month drawing attention to the report of the Consolidated Gold Fields of South Africa, Ltd., for the year to June 30 last mention was made of a sum of £535,000 described as "the net profits of the operating company and retained by its subsidiaries." The phrase should have read "net profits for the year attributable to the operating company and retained by its subsidiaries."

Marsman Investments, Ltd.—The accounts of Marsman Investments, Ltd., for the year ended April 30, 1957, show a profit of £34,504 accruing from "the continued appreciation of the investment in Marsman and Company, Inc." The last-named company reports a profit of P724,237 for the same financial year, an increase of more than P100,000 over the previous year. The mines operating under the management of Marsman and Co. had an output for the year under review valued at P5,228,096. The report states that 1956 was a bad year for the gold mines, both San Mauricio and Coco Grove having had to suspend operations. Satisfactory and expanded operations at Palawan Quicksilver and Palawan Consolidated (chromite) counterbalanced the poor results from the gold properties.

DIVIDENDS DECLARED

* Interim. † Final.

(Less Tax unless otherwise stated.)

***Amalgamated Tin Mines of Nigeria.**—8%, payable Mar. 14.

†Anglo American Investment Trust.—10s., payable Mar. 7.

***Anglo-Huronian.**—25 cents.

***Anglo-Newfoundland Development.**—7½ cents, payable Apr. 3.

†Ashanti Goldfields Corporation.—10d., payable Apr. 4.

†Bibiani (1927).—2·4d., payable Apr. 4.

†British South Africa Co.—3s. 3d., payable Mar. 29.

***Geevor Tin Mines.**—6d., payable Mar. 7.

International Nickel Co. of Canada.—Quarterly, 65 cents, payable Mar. 20.

***Kamunting Tin Dredging.**—4½d., payable Mar. 4.

***Kinta Kellas Tin Dredging.**—5%, payable Feb. 24.

***Mount Charlotte (Kalgoorlie) Gold Mines.**—5%, payable Mar. 1.

†Orange Free State Investment Trust.—2s., payable Mar. 7.

***Pahang Consolidated Co.**—Pref. 3½%, payable Jan. 31.

Pengkalen.—Pref. *1s. and *9d.; Ord. *1s. and *7⅜d., both payable Feb. 7.

***S.A. Minerals Corporation.**—Pref. 9d., Ord. 1s. 3d., payable Feb. 18.

***Southern Kinta Consolidated Tin.**—20%, payable Mar. 7.

***Tekka-Taiping.**—2s., free of tax, payable Feb. 7.

†Vereeniging Estates.—5s., payable Mar. 21.

†West Rand Investment Trust.—2s., payable Mar. 7.

***Western Mining Corporation.**—6d. (Aust.), payable Feb. 26.

METAL PRICES

Feb. 10.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	197	0	0
Antimony (Eng. 99%)	190	0	0
Chromium (98%-99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	28	10	0
Silver		6	4⅛
Gold	12	9	0½
Wolfram (U.K.)		—	
(World)	4	17	6

Tin, Copper, Lead, Zinc — See Table, p. 108.

Alluvial Goldfield in Ethiopia

H. L. Holloway, A.M.I.M.M.

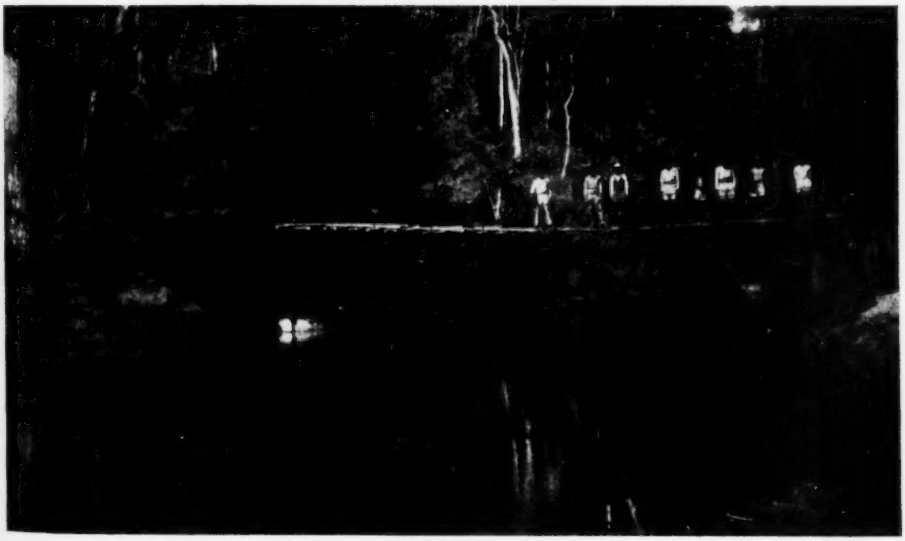
An account of the Kebre Mengist field, south of Addis Ababa

Introduction

The Kebre Mengist goldfields lie about 400 kilometres due south of Addis Ababa in a direct line and about 500 kilometres by road. The centre of the alluvial deposits of this area is some 20 kilometres south-west of the town of Kebre Mengist, this town being shown on most maps under the name of Adola. A main road runs from Addis Ababa through Adola and continues southwards for some 80 kilometres, where it forks, with one branch running to Moyale on the Kenya frontier and one to Dolo on the Italian Somaliland frontier. Although a main road parts of it in the past have become almost or quite impassable in the wet season, but considerable work is being done to improve it under supervision of American road engineers. There is a prospective airstrip at Adola and one serving the goldfields at Adadikoto, with a plane making a more or less monthly trip from Addis Ababa.

Some 100 kilometres of rough but serviceable roads run from Adola to Chakiso Camp, the technical centre for the goldfields, and thence from Chakiso to the other main camps and from Chakiso to the airstrip at Adadikoto. Gold workers and guards with accessory labour number about 3,500 and these are scattered throughout the various camps, the chief of which are—Chakiso, with workshops, garages, and engineering and artisans quarters; Beda Kesa, with a dragline dredge in operation; Gaio; Gora; Dembi, and Regi. Smaller camps exist at various points along the Marmora River and in the bush, where the gold recovery justifies their upkeep.

The true inhabitants of the district are Gudjis, a primitive, Galla-speaking, pastoral



Suspension Bridge over the Marmora River

Resident Engineer's House, Chakiso Camp.

people whose chief wealth lies in their quite considerable herds of cattle. Much of the country is partly or wholly unexplored and it is reasonable to expect other mineral discoveries to be made in the future. The Gudjis are not gold seekers and surely find that the existence of the deposits in their country, with consequent strict security measures, constitutes a good deal of a nuisance to their way of life.

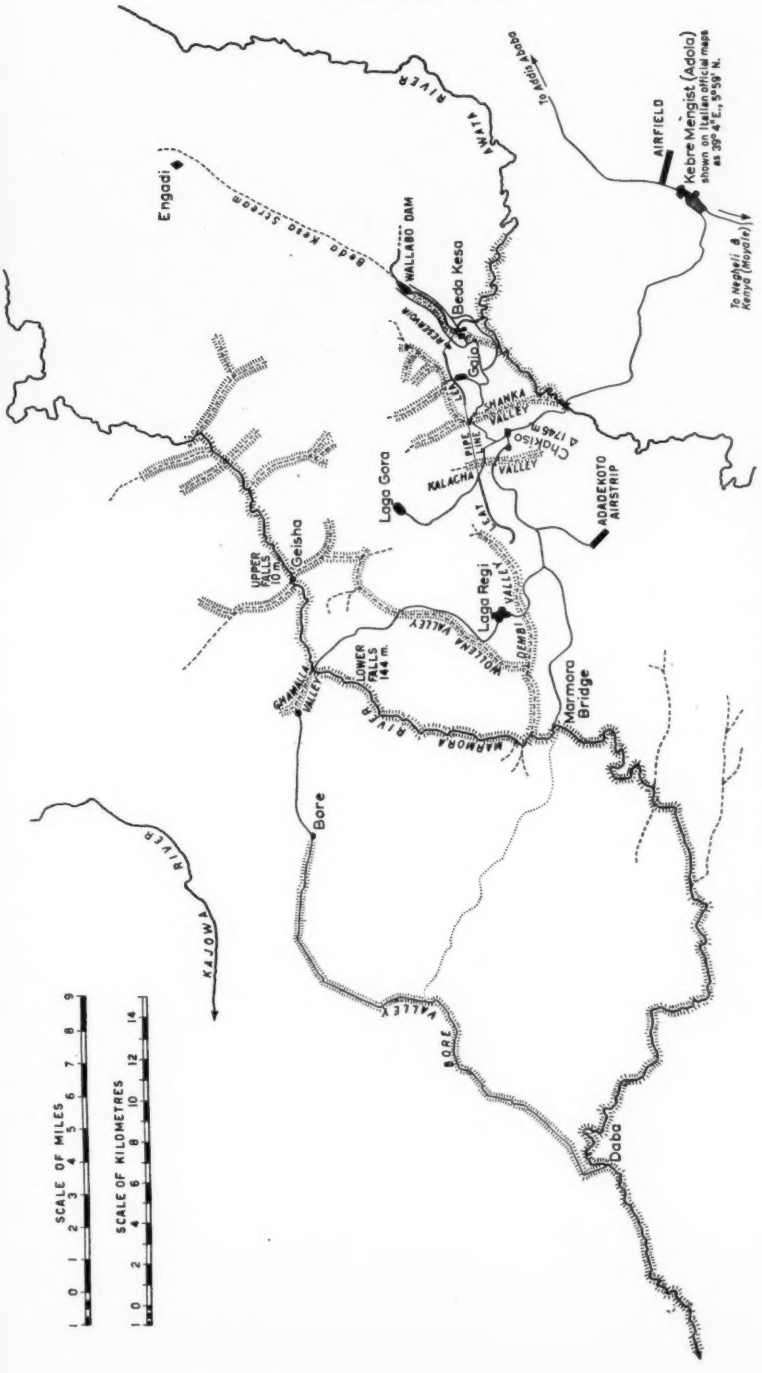
History

Although the existence of gold in the area may have been known to the Gudji inhabitants no production is recorded until after the Italian occupation of Ethiopia. Some initial exploitation was commenced under the Italians and roads were laid out, then after the British reconquest of Ethiopia, production was taken up directly by the Ethiopian Government. Little regard was paid by the officials in charge to mining principles, the system used being random pig-rooting for the extraction of the gravels, which were later washed at the nearest water supply. As the richest spots were searched out and exploited monthly production in the second half of the 1940's reached the considerable figure of 12,000 oz.

The Ethiopian Government was not unaware of the defects of its mining system and several missions under the leadership of European technicians were sent to the fields to report on their possibilities and the best methods of exploitation. Little or no change resulted from the condemnations and recommendations of the missions until in 1950 an American engineer proposed the installation of a dragline dredging plant in the rich Beda Kesa stream bed, with the washing plant carried on pontoons. The recommendation was accepted and in the early 1950's the outfit, consisting of a diesel-engined P. and H. 1½-cu. yd. dragline and a Bodinson washing plant with a diesel engine servicing an electric generator, was bought in the United States, transported to the spot, and erected.

The washing, gold recovery, and tailings disposal units of the Bodinson plant were essentially as found on a simple gold dredge, with riffles fed with mercury as gold savers. One fault was the absence of any device for saving nuggets and a quite considerable proportion of the gold occurs in this form. Apart from this the plant was generally suitable for the ground, which was a shallow waterlogged stream bed with many heavy boulders.

Installation and operation proved far more costly than had been estimated and the gold recovery although high was much below what had been hoped for. This was not surprising, as the estimates of the gold content of the ground had been based in the main on the winnings of hand workers who worked only the richer spots. Other difficulties were the long delays in obtaining spare parts and replacements generally and the cost and delay in transporting fuel oil over the execrable roads from the capital. Disappointment and friction developed and finally the American engineers left and after some delay their place was taken by British



Sketch Map of the Kebre Mengist Goldfield.
(Hatching denotes gold-bearing streams.)

Dragline Dredge at Beda Kesa, 1956.

personnel. These have kept the plant running and have carried out extensive and fruitful new prospecting. Little or nothing has been accomplished, however, in improving the now established methods of hand working.

Prospecting System

Pitting has been chiefly used in prospecting new areas, as most of the areas are water free. The gold-bearing ground occurs along the meanders of old streams, with varying width and often considerable length. A base line is run along the course of each stream bed ignoring minor windings but conforming to the major directional trend. At right angles to the base line lines are laid out at 100-metre intervals with spacing between pit centres of 12½ metres in narrow valleys and of 25 metres in wider flats. Lines are numbered to allow of filling in to 50-metre intervals and pits marked with the letter M always lying on the intersection of the base line. For scout prospection three consecutive lines were pitted per kilometre, leaving seven lines to be filled in later.

Pits are circular, 0·7 metre in diameter, and are carried 0·1 metre into bedrock, below which experience has shown that no gold is carried. Depths vary from a metre or so to 15 metres and in the deeper pits some trouble was experienced with CO_2. As water is extremely scarce in many cases only 0·1 cu. metre of wash is generally sampled after thorough mixing and quartering, the amount being measured in strongly-made boxes designed to carry that amount. The gravel is compressed, but not unduly rammed, in the boxes, the whole of the 0·1 metre depth of bedrock being sampled separately. No account of the swell of the gravel after displacement is taken in working out the gold content, this being held as a safety factor.

Sample headings in the pitting sheets show the recovery from 0·1 cu. metre of wash, the estimated recovery if all wash has been sampled, the recovery from bedrock, and the overall and gravel value of the ground per cu. metre.

In wet ground, when Banka drilling was done, a similar system of spacing is employed. Drilling, however, was not too reliable owing to the bouldery nature of the wash.

Topography and Geology

The developed goldfields cover a block of some 25 kilometres square and they are drained by two perennial rivers—the Awata and the Marmora—each with a mean flow (not counting occasional floods) of some 100,000–150,000 imperial gallons per minute. The rivers run through deep valleys, from

75–100 metres below plateau level in the case of the Awata and 250–300 metres in the case of the Marmora.

The Marmora River has a series of falls quite suitable for the generation of hydro-electric power. The valley slopes are abrupt, but not too precipitous to make the building of steeply-graded roads to the rivers in selected spots unduly difficult. The Awata has a good concrete bridge on the Adola road near Chakiso, but the Marmora has not yet been bridged for mechanical transport.

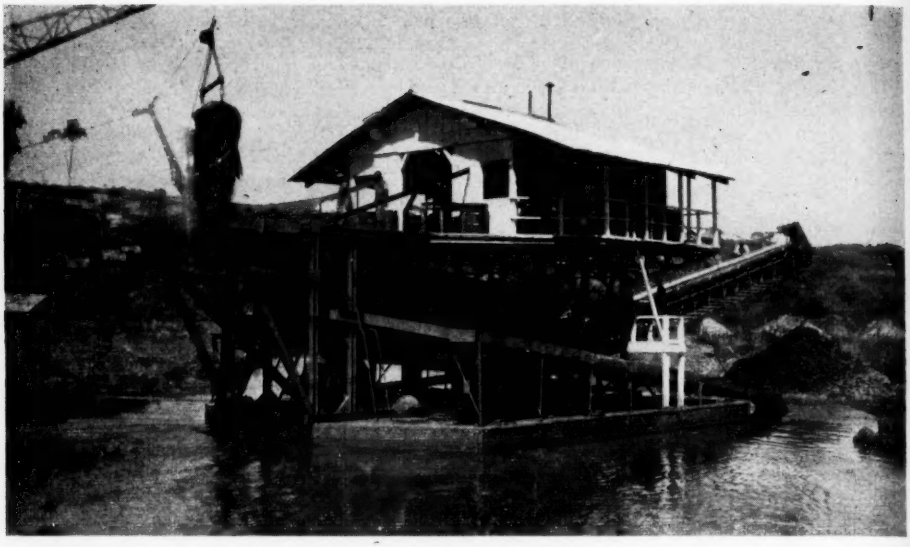
The country is generally covered with forest growth, much of it good commerical timber, but open glades intervene and are at times extensive. The elevation above sea-level at the working centre of Chakiso is approximately 1,700 metres, with hills rising above 2,000 metres. Even in the wet season there is little surface water flow in the valleys, which have their inception in the high plateau and which progressively deepen as they near their junctions with the two main rivers. Exceptions to the general lack of surface flow are the Beda Kesa, the Shanka, and the Kalacha valleys (shown in the accompanying map), where there is a varying flow during part or most of the year. Over most of the goldfields even after heavy precipitation the rainfall is quickly absorbed into the sub-soil and pits sunk up to 15 metres deep in valleys draining considerable areas failed to reach the underground water-table even in the wet season.

The most common rocks in the area are crystalline schists, with massive dykes and sills of basic intrusives. There are local occurrences of biotitic and other granites as well as some pegmatites. No gold-bearing veins have been discovered, although systematic prospecting for such occurrences has not been carried out. However, as the hand workers range the district looking for new fields it is likely that any surface outcrops of gold-bearing reef would have been noted. It is probable that the alluvial gold is residual, resulting from strata long since carried away by erosion.

Gold Deposits

The most prolific sources of gold have been the various stream valleys which cut the rugged countryside, with the Beda Kesa prominent. The two main rivers—the Awata and Marmora—also carry gold in their present courses and in the past have deposited the metal in terraces on the slopes of their valleys. The gold is water worn and usually coarse; nuggets of 5 oz. to 10 oz. are not unusual and have been found up to 40 oz. About two years ago a nugget of 35 oz. was dug up by the dragline bucket at Beda Kesa

Washing Gold, Beda Kesa.



Gold-Washing Plant.

and retrieved from the stacker belt of the washing plant.

Some attempts at ground sluicing have been made at Beda Kesa and along the Marmora River, but the usual method of recovery is for small groups or single individuals to go pig-rooting where fancy or experience lead them with often a long carry to a supply of water for washing the gravel. Depths of overburden vary from a metre or so up to 10–12 metres and, where the greater depths obtain and the gold content is attractive, underground mining is carried on with little regard to safety precautions. The mines are State-owned and the hand working is carried out entirely under Ethiopian supervision. The mining methods have become so firmly established that it would be a major undertaking to change them.

Early trials have been made at constructing earth dams, usually resulting in wash-outs, but at Wollabo, above Beda Kesa, a strong dam has been built under engineering supervision and the impounded water serves the dragline dredging plant and for ground sluicing of terraces along the Beda Kesa valley. Along the Marmora some leats have been dug to divert water for ground-sluicing terraced deposits. No gold-winning appliances—such as, sluice boxes, long toms, or rockers—are used and all concentrate washing is done in wooden bateas approximating in form to those used in Ecuador and Colombia. With these the gold workers are very expert. The return per man actually gold washing is from 0·75 oz. to 1 oz. monthly on an average and the return from the whole field is from 1,400 oz. to 2,500 oz. according to the season.

There is a progressive diminution in yearly yields, which may be expected to continue unless more rational working methods are introduced. Much gold has been left in the hand-worked ground, except in the limited areas where ground sluicing has been carried out. With such partly-worked out ground the cost of bringing in water for normal paddock working would now in most cases be uneconomical, even if the State officials agreed to the change. What will probably happen will be that present methods will continue a few years more until the ground no longer gives the labourers a living wage. New and unspoilt areas do offer the chance of increasing production by the introduction of suitable machinery and the bringing in of water from the main rivers. Along the Lower Marmora there are extensive flats which carry gold, but whether in payable quantities or not would have to be proved by drilling. As already mentioned there is much unexplored country offering an attractive prospecting field.

Climate, Labour, and General

The climate in the goldfields is generally healthy, although at less than 1,400 metres above sea-level there is considerable malaria. On the higher plateau there is almost a total absence of such pests as disease-carrying mosquitos, tsetse, etc., and away from cattle herds or unusually unsanitary surroundings ordinary flies are not troublesome.

The year can be roughly divided into seasons governed by precipitation, with a dry period from November to March, when scarcely any rain falls, a primary rainy season from mid-March to mid-May, a slackening rainy season from mid-May to mid-September, and a secondary heavy rainy season from mid-September to mid-November. These seasons are not constant apart from the main dry season. No permanent record has been kept of the rainfall, but in 1956 it was 40 in., which was probably well below average ; in April, 1957, it was over 16 in. for the month. The temperature varies from 41° F. to 95° F. in the dry season to 50° F. to 77° F. in the rains.

The Ethiopian workers are on the whole of poor physique and cannot compare with West Africans in work accomplishment. The constant fasts imposed on them by the Coptic religion do not conduce to stamina and neither does the usual diet of Injira—a kind of bannock made from Tef flour, eaten with highly-peppered sauce. The Gudjis make butter, but much of this is used as a primary covering for their persons, including their heads. There is much disease, especially venereal, but the death rate is comparatively low.

Labour is not difficult to handle, where reasonable tact is used, but between themselves violent quarrels occur often resulting in stabbing affrays. Some aptitude is shown for mechanical work and the better educated take readily to tasks requiring intelligence—such as surveying—but close and prolonged application to any job is somewhat out of character. The Gudji inhabitants are content with their pastoral life and do not take work as labourers. In addition to cattle they breed goats, donkeys, and mules. The latter are much used as saddle animals.

There is a primitive hospital at Chakiso, with a resident European doctor to give some kind of medical care to the gold workers and others living in the vicinity, but many prefer to go to native healers who combine a little knowledge of simples with much superstition and ignorance.

Treatment of Tin Slags

C. W. Jensen

Recovery of tin and tungsten from old slag dumps.

Introduction

During the Korean War, when tungsten prices rose to an abnormal level, it was proposed to develop a special process to extract tin and wolfram from big slag dumps near old tin smelters in order to find an economical process for the extraction of both tin and tungsten. The tin smelters concerned were shut down and dismantled 50 or more years ago.

A survey of the slag dumps showed an average composition of the slags of about 2% tin and 2% tungsten.

(1) Laboratory Tests

Tests were made with samples of the old slags on a laboratory scale, these showing that no solution to the problem could be obtained by approaching it in the orthodox way—*i.e.*, extracting the tungsten first by soda treatment and volatilizing the tin in the leached residues later on. The extraction of tungsten from the slags was very unsatisfactory, either when leaching or pressure leaching the slags with soda or calcining them with soda, or combining one or the other method. However, the final results suggested

that, in so far as the tin could be volatilized quite effectively with the addition of coal and gypsum, part of the tungsten could probably be recovered in the form of an iron-tungsten alloy.

During the tests referred to it was not settled finally as to whether it would be possible to tap such an alloy direct from the furnace or whether it would be better to recover it from the residues of the furnace by wet or magnetic separation.

(2) Pilot Plant

A small pilot plant was next erected and tests run based on the experience obtained during the laboratory tests.

In the pilot kiln the tin content of the slags could be volatilized very efficiently by adding coal and gypsum, but the recovery of tungsten from the kiln residues proved much more difficult. It could not be recovered by simple magnetic separation because not all the tungsten was alloyed with iron, some of it being present in the form of tungsten carbide or very small metallic tungsten particles.

Tests with panning the kiln residues gave much better results. As a consequence two riffle tables and a Hardinge mill were added to the circuit and a washery section put into operation. However, tungsten recovery from the residues of the pilot kiln was still, in spite of all efforts, not very satisfactory, only about 50% of the tungsten content being recovered in the form of concentrates.

After further elaborate tests it was found that the addition of gypsum had a marked influence on tungsten recovery. By the addition of gypsum to the kiln iron sulphide was formed. Such iron was not available to form iron-tungsten alloy, however, while the tungsten metal, or tungsten carbide formed was of such small particle size that a large part of such small particles entered the tailings and were lost.

(3) Full-Scale Operation

The final technique adopted, which is illustrated in the accompanying flow-sheet, was to abandon the addition of gypsum to the pilot kiln and increase the formation of iron-tungsten alloy. To this end :—

The excavated slags were crushed to *minus* ¼ in., stored in bins, and proportioned out of these bins on a cross-belt conveyor. On to the same conveyor anthracite duff was measured from other bins and the mix elevated to the feed pipe of the kiln. The kiln was fired with oil and a temperature of 1,260°–1,270° C. maintained at the discharge end and 300° to 400° C. at the feed end.

In the kiln the tungsten content of the slags is reduced to metal and this alloys in part with metallic iron reduced from the slags partly to tungsten carbide and partly remains as metallic tungsten. The tin is volatilized as tin sulphide, the sulphur content of the chemical coal added being just sufficient to provide the necessary sulphur.

At the beginning of operations iron-containing fluxes were added to the kiln to provide the necessary iron to alloy the small tungsten particles and to form the larger particles of iron-tungsten alloy. This addition, however, had the disadvantage that the concentrates obtained in the washery were reduced in tungsten content from 8 to 9% down to 4 to 5%, so that this addition of iron fluxes was abandoned after a time. Thereafter the recovery of tungsten in the form of concentrates on the tables was increased from 50% to 75% by careful adjustment, but the tin recovery in the main kiln dropped from 80% to about 70% when the addition of gypsum was abandoned. The tailings contained from the first ran less than 1% tungsten, but by improving the performance in the washery that was reduced to 0·7% and below. However, even after doing away with the addition of iron fluxes in the kiln, the concentrates produced still contained only 6% to 7% tungsten—*i.e.*, the iron content of the tin slags treated was rather high, while the low tungsten content could not be avoided.

The extraction of tungsten from the concentrates obtained in the washery presented another problem. Oxidation of concentrates in the open air took quite a long time and even then the extraction of tungsten from such oxidized materials by soda leaching was not very successful. It was decided, therefore, to change over to calcining the concentrates with soda in the pilot kiln, but this operation was again unsuccessful for heavy accretions built up inside the kiln so that it was not working for half the time owing to the necessity of removing the accretions. The solution to the problem was finally found in recycling 50% of the calcined concentrates with 100% freshly-produced concentrates. Thereafter there was no trouble with accretions forming at all.

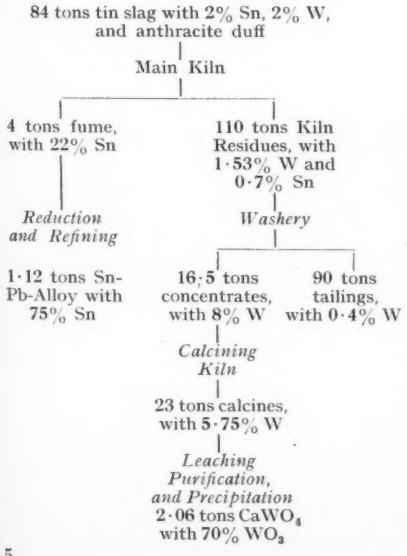
The extraction of tungsten from the calcines was done by leaching with hot water, whereby sodium tungstate solution

was formed with a strength of 40 g./l. WO_3.

During the first weeks of operation the leached residues contained up to 1·5% W, which was not at all satisfactory. Such residues were recycled into the main kiln and by careful supervision of the calcining process the recovery in the leaching plant was increased considerably. In the end the leached residues contained 0·9% (and less) tungsten and could be discarded.

The sodium tungstate solution was partly neutralized with hydrochloride acid and precipitated with calcium chloride. This formed a crude calcium tungstate containing a certain amount of calcium carbonate. The precipitate was filtered off and slurried with water and then recycled in the tank. By adding more hydrochloric acid the surplus calcium carbonate was removed and a calcium tungstate produced assaying 68% WO_3. This product contained a small amount of tin, sulphur, and phosphorus as impurities. The tin content was usually inside the limits allowed (where the phosphorus content was very low at the beginning, well inside the limits), but the sulphur content was very high indeed (1% to 1·2%). However, the sulphur, present as calcium sulphate, could be removed by washing with hot water eight or ten times, which, of course, is a lengthy but cheap operation.

Weekly Flow-Sheet


84 tons tin slag with 2% Sn, 2% W, and anthracite duff
Main Kiln
4 tons fume, with 22% Sn
110 tons Kiln Residues, with 1·53% W and 0·7% Sn
Reduction and Refining
Washery
1·12 tons Sn-Pb-Alloy with 75% Sn
16·5 tons concentrates, with 8% W
90 tons tailings, with 0·4% W
Calcining Kiln
23 tons calcines, with 5·75% W
Leaching Purification, and Precipitation
2·06 tons $CaWO_4$ with 70% WO_3

As time went on the phosphorus content of the calcium tungstate produced rose above the maximum laid down by the customer (0·06% P.). In addition there were complaints about the high silica content. It was in consequence arranged to precipitate the silica during leaching with ammonium chloride and to precipitate the phosphorus with magnesium chloride.

For the treatment of the tin fume produced by the kiln a reverberatory furnace was built and a cast-iron refining pot was installed, both plants being oil fired. The tin fume was reduced with coal, using soda as a flux. The crude tin recovered melted in the pot was refined in the orthodox way—*i.e.*, removing the iron by stirring and drossing, removing the copper by addition of sulphur, removing the zinc by the addition of ammonium chloride, and removing arsenic by the addition of caustic soda. The capacity of the reverberatory furnace was 1·5 tons of fume treated per day and the production of about 2 tons of tin-lead alloy per week.

(4) Economics

The process described is a profitable proposition for slags containing 5% (Sn + W) with tin and tungsten at about £700 per ton.

Tubular Engineering

Last month Tubewrights, Ltd., afforded an opportunity of seeing their latest film, designed to show the present stage in the development of the use of hollow sections for structural purposes. The giant booms already at work with the draglines stripping overburden in the Northamptonshire iron-ore fields have been joined by the sea-boring tower being employed by the N.C.B., while the company also designed and made what is described as the world's highest all-tube self-supporting structure, a radio mast at Gibraltar 603 ft. high. Large aircraft hangars have also been built in tube, while for conveyor bridges also the hollow section has proved ideal. Some miles of such bridges have been erected throughout Britain at collieries, power stations, and other large works, a major factor in their use, it is suggested, being the speed and ease of erection on sites where difficult conditions are encountered.

The field for the future development of the hollow section is thought to be most extensive.

Congress in Canada

Further notes on the recent tours by Congress delegates

John A'C. Bergne, A.R.S.M., M.I.M.M.

Fabled Yukon

After Kitimat, with its precise aluminium metallurgy, fabled Yukon was a marked antithesis. The impression of mystery is heightened by the nature of one's introduction to this northern fastness. Whether by the sheer physical effort of climbing the Chilkoot and White Passes, or entering by the spectacular White Pass and Yukon Railroad, or, as our party did, by flying along and then over the fiords, peaks, and glaciers of the Coast range and the still higher St. Elias mountains, the impression is the same, of a formidable frontier guarding a pristine land with unabated jealousy in spite of a 60 years' acquaintance with miners and their work. But if the land gave that impression not so the local organizing committee of the Congress. From the moment we touched down on the great runway at Whitehorse these men made the most of their opportunity to unfold to us their manifold mineral prospects and the opportunities for finding more.

It is difficult for sourdoughs to forget the great days of the Klondike gold rush. Robert W. Service's poetry is a living thing there still, but combined with this nostalgia there is the very real and very Canadian urge to open up the country. Their twin problems, as in all Canada but here to a marked degree, are simply and starkly climate and transport. Much work has been done on the part of the Federal Geological Survey and perhaps a little under half the country has now been mapped in some detail, but this does not deter prospecting parties, grubstaked by small syndicates or financed by many of the well-known companies, from exploring virgin land; over 20 such parties were active in the Territory during the 1957 season. But air support is not quite so easy as on the relatively flat lake-studded north-central shield.

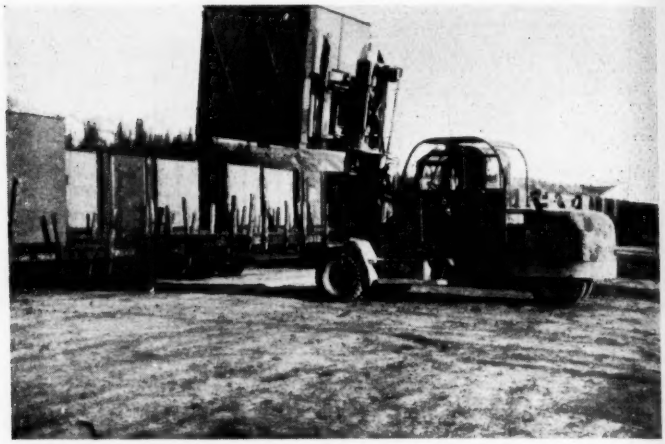
It is safe to say that the Alaska Highway has done more to open up this northern land than any other single engineering feat, yet only the exigencies of war could disgorge the capital necessary to construct this 1,700-mile gravel road and its upkeep must be a big drain on public funds. Other major roads stem off from this backbone—such as,

Whitehorse from the Air.

Sketch Map of the Yukon and Bordering Areas.[1]

the Dawson City loop, the Haines road, the Cassiar road, and the Canol road and pipeline to Norman Wells on the Mackenzie river, the wartime source of oil. Some of these—as, for instance, the last-named—have been abandoned temporarily, but public demand has forced the authorities to change their minds. From these branch roads spread again the subsidiary roads and tracks of privately-financed enterprises. But road-making here is not the easy course of a hot semi-desert country. Muskeg, permafrost, and mountains combine to render road-making difficult and expensive. It is interesting to note in this connexion that a bulldozer

[1] From PIKE, A. E. *Western Miner*, Nov., 1957.



Container Freight at Whitehorse.

driver can get $900 a month. He is undoubtedly the most important man in roadmaking. Tolls are sometimes imposed. The Whitehorse-Mayo road is financed by charges including the tare weight of vehicles at $1 per ton. Other items are ores $4·00 per ton and food $2·00 per ton.

Dawson City is off the main through route and though on a loop road has, as a consequence, lost its status as the capital city to Whitehorse, which is now the communication centre of the entire area. A major airfield, the terminal of the railway to tidewater at Skagway and the Alaska Highway, together with the outmoded but still available river navigation on the Yukon itself, have combined to give Whitehorse a strategical position second to none. The production of asbestos at Cassiar, just over the border in British Columbia and the high-grade silver-lead operations at Keno Hill provide an appreciable volume of export traffic which presumably also includes the gold, about 50,000 oz. annually, from dredging operations near Dawson. The transport costs, however, are prohibitive ($59 per ton of concentrates, Keno to Trail smelter) and it is only the high silver content of the lead concentrates that makes the long journey to a smelter worthwhile. Alaska needs a major find to bring a smelter into the Territory with all the ancillary engineering undertakings that that implies and to develop the resources in hydro-electric power, coal, oil, and timber that this vast area undoubtedly possesses.

The writer was most disappointed when his aircraft found a patch of mist over Dawson airfield and could not land. Others were more fortunate and saw the famous city in its beautiful autumn setting. It is to be hoped that the reported asbestos finds nearby to the north and west will develop into an industry of sufficient size to revive this renowned spot in mining history.

Regretfully we turned away from Dawson and swung up the Klondike valley towards Mayo airstrip and the Keno mines. Easily seen from the air were the scars of the mining upheavals of former alluvial workings together with their canals and water leats. At Mayo we had our first taste of the midge pest for which the Canadian north is famous in the summer, but they seemed to favour the lower-lying ground and were not noticed in the hills.

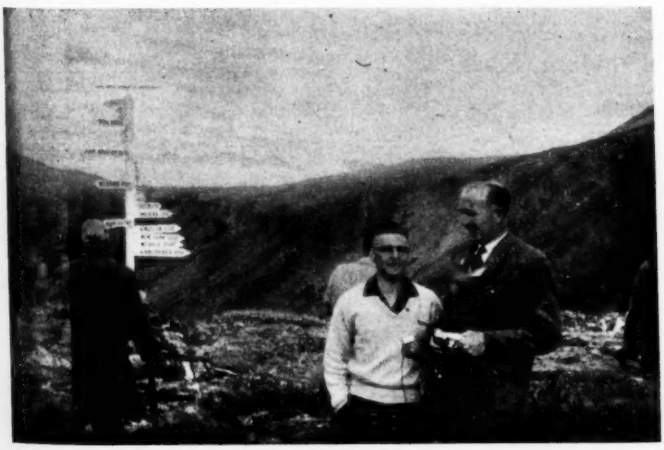
Keno

From the airstrip an excellent road, 29 miles long and recently constructed, took us to the properties of the United Keno Hill Mines, Ltd. This company is the successor to the Treadwell Yukon company, a name well known to British mining circles. The former organization closed down in 1942 after recovering some 44,000,000 oz. of silver and nearly 48,000 short tons of lead from some 625,000 short tons of ore, the highest grade exceeding 100 oz. of silver per ton. The new organization has, since 1946, when production started again, mined 1,000,000 tons of ore from which 30,000,000 oz. of silver, 82,000 short tons of lead, 60,000 short tons of zinc, and some 750 short tons of cadmium have been recovered.

The first discovery of lead in this district was made in 1906 when the Klondike field was settling down to dredging and individual prospectors were starting to scour the surrounding country in earnest, but it was not until 1919 that a find of major importance was made at the top of Keno Hill and gave rise to the Treadwell Yukon company. The ore occurs as irregular bodies filling two sets of faults where junctions or changes of strike occur. Post-mineralization faulting has disturbed these bodies. The country rock consists of alternating bands of quartzite and schist rarely more than a few feet thick individually, among which are diorite sills, now altered, sometimes act as a control. The primary mineralization consists of galena, sphalerite, and minor tetrahedrite in a manganiferous siderite gangue, but oxidation has persisted to a depth of about 400 ft. and gives rise to secondary minerals—such as, anglesite, cerrusite, native silver, ruby silver, and copper carbonates. None of the ore-bodies is of any major size and workings are scattered over a number of miles. The mill at Elsa is connected with the principal producers at Hector and Calumet mines by an aerial ropeway. Combined production for United Keno is approximately 13,500 tons per month. Other companies are also working in the vicinity.

A visit was paid underground at the Hector mine during the graveyard shift, as it was the only time available. The ground is very heavy. Drifts on vein, which have a 70° dip to the north-west, are kept open with sets of 10 in. diameter timber with a 4 in. diam. spreader beneath the cap ; 15 in. spruce stulls were seen. The ore is very soft and drilling speeds of 15 in. per min. and upwards are easily maintained, while blasting is very light as the material requires little loosening. The advance is carried out by spiling for which 10-ft. lengths of 1-in. quarter-octagon steel are used. These are driven in by jackhammer from which the rotating pawls have been removed and 6 to 7 steels are used per set, sometimes on the sides as well as the roof. Set spacing is at the round interval, which varies from 5 ft. to 6 ft. The two-man crew performs all the duties, including timbering and mechanical mucking and tramming. The latter is accomplished with the use of battery locos. working to a limit of 1,000 ft. haul ; above that figure special contract rates apply. The spiling steel is withdrawn by means of a Sylvester prop extractor and round lagging up to 6 in. diameter is substituted ; 4 in. bracing is used between sets, which measure 7 ft. by 7 ft. inside.

The vein width varies from 3 ft. to 20 ft. and averages 7 ft. Where the width is over 12 ft. square sets are employed. In the narrower portions of the vein a mining system is employed which is known locally as the " longwall " system. This bears no resemblance to the coal-mining method of that name so well known in the British Isles, but consists of advancing what is in effect a two-compartment stulled rise slowly along the strike over the full height (125 ft.) between levels working from top to bottom—*i.e.*, underhand—and never allowing more than two compartments to be open at one time. This system demands the emplacement of fill



Keno Hill, with its Signpost.

by hand in small quantities and the use of 13 bd. ft. of timber per ton of ore. Chain-link steel fencing wire is used to brattice off fill from the manway and ore-passes. As the ore and muck are both sticky it is important that the rises are kept on maximum dip to ensure clearance of the ore or fill passes.

A big expense where wages are high, as at this property, is that of hand-stowing of fill in stopes. There have been occasions in the past where difficulties have been experienced owing to the impossibility of keeping open more than a small area in a stope so that hand stowing in small frequent applications is thought necessary. It is possible, however, that mechanical stowing could be introduced if the fill is compacted by the stower to a degree sufficient to keep open the walls immediately surrounding the excavation.

The mill has a capacity of 500 tons per day for flotation and in addition a cyanide plant with a capacity of 350 tons per day for the treatment of flotation tailings. The latter is not being used at present, but the current milling rate for the former is approximately 440 tons per day. The coarse-ore bin is arranged to take delivery from aerial ropeway buckets, mine cars, or trucks. The primary crusher is a 10 in. by 20 in. Traylor and this is followed by a screen in closed circuit and then by a " Low-head " screen with a small gyratory crusher taking oversize and returning crushed material to the first screen. Ball-mills with Akins classifiers in closed circuit follow, the ground finished product going to two parallel flotation sections.

The flotation section follows standard practice, with lead and zinc concentrates being cleaned and re-cleaned. Little oxidized material is now mined but the tailings carry about 0·6% oxidized lead. Table 1 gives the assay of mill feed and products. The average

Table 1

	Silver, oz. per ton.	*Lead, %*	*Zinc, %*	*Cadmium, %*	*Iron, %*
Average mill feed	38·3	7·4	6·4	—	—
Pb. concentrate	334·6	68·1	5·1	—	—
Average Zn concentrate	15·9	0·9	56·3	0·8	5·4
Flotation tailings	3·8	0·6	0·9	—	—

moisture content of the concentrates is 9% and these are shipped in two-ton collapsible containers measuring 60 in. by 30 in. by 15 in. deep, the bottoms, ends, and sides being made of ½ in. waterproof plywood held together by rectangular loops of 1 in. by 1 in. by ⅛-in. angle iron carried loose and fitted separately at top and bottom with a single ½-in. plywood spreader across the centre. The concentrates are loaded from belts into these containers, which are lined with old sacks and covered with cellophane, the whole package being held in place by two steel tape packing bands and mounted on a pallet. At the time of writing the zinc concentrates were being stockpiled in their containers. Approximate costs were as given in Table 2.

Table 2

	$
Mining	19·00
Inter plant delivery	0·60
Stock piling	0·10
Milling	3·50
Administration	4·00
Concentrate transport, smelting, and marketing	14·50
Total	41·70

Recoveries were stated to be 92% silver, 93% lead, and 88·5% zinc. The 1956 report gave metal sales equivalent to $62 per ton.

Power is obtained from the recently-installed hydro-electric plant some 29 miles away on the Mayo River, erected and operated by the North-West Power Commission under guarantee from United Keno to take 1,600 h.p. at $125 per h.p.-year. The original 3,000-h.p. equipment is currently being duplicated; the transmission is at 39,000 V. In addition to this public supply some 2,200 h.p. is available in a standby diesel plant at Elsa and coal produced at the company's Carmacks mine is used to fire the steam plant for building and house heating in the winter.

The average wage at Keno was about $25 and contractors earn as much as $36 per man per day, but even at that figure there was a large turnover of labour, notwithstanding a

Table 3

	$	
Vancouver purchases (ordered in 6-monthly consignments).	100·00	
Locally purchased	140·00	
Personal items	20·00	
Sickness and hospital Insurance.	10·50	
Pension plan.	100·00	(+ $100 provided by the Co.)
House rent, including heat and light.	30·00	
Total	$400·50	

charge of only $3 per day messing and washing and $1½ per day for the bunk house.

The bachelor delegates were housed in an excellent bunk house constructed of solid tongued and grooved 4 in. by 5 in. timber after the fashion of log-cabin construction. Comfortable two-man rooms approximately 10 ft. by 12 ft. were equipped with hanging cupboards, easy chairs, beds, etc., and the sanitary arrangements were excellent. Other bunk houses could be seen which appeared to be of the same type. Some 20 or 30 cottage-style married quarters were seen at Elsa, there are probably more at the other camps. An interesting conversation at dinner gave a typical monthly budget for a family of five, as set out in Table 3, Two members of this family each contributed $70 a month towards the budget. The same informant said that every employee's return fare is paid by the company yearly for one month outside. Married employees have their wives' fare paid every other year.

Ore Dressing Notes

(6) *Flotation.*

Phosphates on Belt

In the December, 1957, issue of the *Engineering and Mining Journal*, a description is given of the flotation process used by the Coronet Phosphate Company, of Florida. In this the coarser phosphate in the *minus*-20 *plus*-48 mesh rock range is floated on continuous belts instead of with the agglomerating tables normally used. Between 400 cu. yd. and 450 cu. yd. of matrix are mined hourly and pumped to the plant about half a mile away. The deposit contains 3% to 4% of " pebble " and up to 40% of clay. The *plus*-14 mesh pebble is removed in a washery and the undersize is deslimed in cyclones of a special design. The overflow, at *minus* 150 mesh approximately, is rejected and the underflow carrying about 60% solids is split by sizing in hydraulic classifiers. The *minus*-65 mesh material is floated along conventional lines ; the coarse (*plus* 16 mesh) goes to the finished pebble stockpile and the intermediate material is delivered to the belt concentrate section. After further dewatering and desliming in a spiral classifier the sand is conditioned in a drum with caustic soda, tall oil, and fuel oil. It then passes to one of three 42 in. wide belts on 70 ft. centres, where it is roughed. The pulp drops on the upstream end of the inclined belt and is turned toward the centre by a system of bars and baffles, which also give turbulence and mixing. The baffles lead the floating agglomerates over the sides of the belts, while water jets entrain air to give the needed aeration along the length of the belt ; the " glomerules " are assisted by the water overflow on to the parallel launders, but silica stays on the belt and goes straight to the tailing pond. The glomerules are dewatered in another spiral classifier and then sent to one of two cleaner belts for upgrading. The concentrate from these belts is dewatered, de-oiled with sulphuric acid, again dewatered, and sent through normal flotation, where silica is floated away with amines. The phosphate is now ready for drying and despatch.

(7) *Construction.*

An Underground Mill

The Northern Mining Company had an extremely difficult problem to tackle in siting its new mill in Greenland. The lead-zinc deposit was discovered in 1948, developed between 1952 and 1954, and by March, 1956, a 360-ton flotation plant was in operation. Ships arrived in August, 1952, with the pioneer equipment needed for drilling and establishing some sort of order in the barren country. In view of the location an airport was the first job put in hand and this was ready within two months. The vein of quartz which bears lead and zinc varies from 7 ft. to 40 ft. in width and dips 60° to 80° through sandstone, outcropping 1,670 ft. above sea-level. Ore is at present hauled on the main level 1,380 ft. above sea-level to an underground crushing station. This material carries between 70% and 80% of gangue mineral, the values being principally coarse-grained aggregates of galena and sphalerite, with some oxides, sulphates, and carbonates of lead, zinc, iron, and copper. There is also barytes and clay, the latter on the hanging-wall. Laboratory and pilot-plant tests were made at Boliden and in view of the isolation of the proposed plant only a few well-known types of machine were decided on, so as to reduce the need for spare parts. Since fine-grained types of ore are expected a conven-

tional flotation plant was chosen. Water shortage during the winter is a serious problem, only 40 gal. or 50 gal. a minute being available between December and April for all purposes. The utmost possible reclamation of water is therefore practised, but this is complicated by contained clay. Concentrates are sacked and stored in the open air on pallets. Experiments are being made with briquetting this material. The area has an annual mean temperature of 19° F. and is *minus* 4° F. from December to February inclusive. Stream water in winter is barely above freezing point and permafrost produces other building problems. The surface skin thaws in summer and then can twist and crack foundations. There are no local building materials and high transportation costs must be allowed for.

These considerations, together with the fact that under the ore-body the sandstone rock has a natural temperature of 34° F. and a good structural strength, dictated the placing of the mill underground. The design allows for crushing, grinding, flotation, thickening, filtration, and drying furnaces, besides a diesel power plant and air compression in chambers cut in the solid rock. Design was completed by January, 1955, and excavation began in the next month; 460,000 cu. ft. of sandstone was shifted by August and in February, 1956, the mill was ready to start producing.

The only change the visitor can see to-day is the dumps of sandstone on the hillside, a chimney for exhaust gases, and a large oil tank. In due course the sacked concentrate will also be visible. Crushing is in two stages, finishing with storage in an ore-pass rise with a 24-hour mill capacity above the flotation section. There is a rod-mill for primary grinding and a tube-mill for middlings regrind after flotation. The Boliden type of flotation cell using low-pressure air is standardized. The rod-mill grinds the ore from 15% *plus* 1 in. to 5% *plus* 48 mesh in one step. It usually works in open circuit, but a rake classifier is available. An unusually high solid/liquid ratio (1·0 to 1·2) is used when water is short, but the best grinding conditions are found with a greater dilution. One purpose in going straight from open circuit to flotation is to give selective grinding of galena and sphalerite with the minimum over-grinding. The lead-zinc middling is dealt with in a small tube-mill. Concentrates are dried by the exhaust gases from the diesel engines. These are situated in the next chamber to the filter and furnace room and provide the electricity, warm water for the plant, and water for the camps. The mine works for a ten-month year, being shut during December and January when the water supply is low and conditions for workers very difficult.[1]

(7) *Comminution.*

Cement

In a paper in the *Transactions* of the American Institute of Mining and Metallurgical Engineers for October, 1957, W. R. Bendy gives an interesting review of changes in practice in the preparation of cement. Although perhaps not of direct interest to mineral dressers the fact that grinding is a dominant cost factor makes it useful to know something of the conclusions reached in the cement industry, as they present many parallels with those used in ore-dressing. Raw materials are ground to between 80% and 90% *minus* 200 mesh, burned, and cooled, the resulting clinker being then ground to about 92% *minus* 325 mesh. Impact and attrition grinding in a ball-mill has always been favoured and 32 kW hours per ton of finished material is consumed in the grinding mills alone. In the early days the clinker was ground in two stages and this was followed by assembling the stages in a single mill with several compartments. Open-circuit mills, however, always met with the problem of tramp oversize in the product. Such devices as perforated screen plates and wire mesh screens in the mills themselves were brought to a high pitch of efficiency in order to deal with the problem either of reducing feed rate and as a result over-grinding a substantial part of the material, or maintaining a good feed rate and having an undesirable amount of tramp oversize. This did not meet the problem of the final stage which could not be controlled by screening. The solution was the development of the air separator. This in cement milling is considered by the author not to produce a clean separation of *minus* 48-mesh material, but it *does* produce a clean fines and tailings cut. The tailings recirculate through the mill and there is some gain in output. The objective in cement grinding is to produce a controlled specific surface area and, as a consequence, a plastic and workable concrete. Too great a reduction in the proportion of fine particles might be undesirable.

[1] *Min. World* (San Francisco)., Nov., 1957.

With the growth of air separation modern installations often use a closed-circuit compartment mill. It is equally feasible to use a short ball-mill instead of a multi-compartment one provided the clinker is first crushed to about *minus* ½ in. The typical requirements in a 1,500-h.p. American plant are a 12½ ft. by 18 ft. ball-mill, a 10-ton service crane, a 16 ft. diameter air separator, a 270 ton per hour elevator handling a 600% circulating load and a 21,000 cu. ft. per min. dust collector. The common primary material is limestone, although cement rock, marl, or marine shells are sometimes used. Secondary materials may include shale or clay. Raw material takes between 12 kW. and 22 kW. hours per ton and the clinker some 32 kW. hours per ton to grind. Owing to calcination loss the weight of dry raw material ground is about 1·6 times that of the finished cement. In the older plants the raw materials were dried in rotary dryers before grinding. To-day they are flash dried in the air separator. The tailings from this machine are practically dry and form the feed to the mill. A hot-air furnace must be provided for keeping the air fed to the air separator up to the required drying temperatures.

(8) *Flotation.*

Modified Bubble Pick-Up

In a short paper Dr. S. C. Sun and R. C. Troxell recently gave details of a modification of the bubble pick-up method, which is increasingly used in flotation testing.[1] The pick-up technique has the merit of extreme simplicity and it has two other advantages over contact-angle measurement. The first is that since the particles are actually raised and held in a bubble which is first pressed to them at the bottom of the containing vessel there is an element of dynamic grip which is missing in straight contact-angle measurement. The second is that if the full load thus raised is moved to a quiet part of the containing cell and the bubble holder is then tapped gently the more lightly held particles drop and can be specially examined. It is then possible to observe any microscopic differences between particles which still cling under such circumstances and those which are displaced. The worker thus has three types of particle to examine for each test. Bubble pick-up testing has, of course, the further merit that changes in solution concentration and pH can speedily be made and a fairly large number of tests can be run through in a comparatively short time.

In the modified method described a bubble-holding tube is used and it is equipped with rubber tubing sealed above by a pinch-cock so that a bubble can be extruded, pressed down upon the mineral in the beaker, and then drawn back into the bubble holder with the load of captive particles still on it. It is thus possible to remove the lifted particles and place them on an optical flat surface for drying and further examination and test. In addition to this easily-made tube a beaker, reagents, a glass rod for stirring the particles in the beaker, and a microscope complete the equipment. No polishing of the mineral sample is required. The glassware and bubble holder must be cleaned and rinsed with distilled water. After this about half a gram. of correctly-sized mineral particles are dropped into, say, 200 c.c. of distilled water in a beaker and tested, if required, for non-adhesion. If they are naturally floatable and it is required that a start be made from the point where they refuse to make clinging contact with an air-water interphase they can be rinsed with dilute acid or alkali until zero pick-up is attained. The mineral being satisfactorily clean adjustment to the desired pH is made and it is possible to speed operations by having a number of beakers each with suitably prepared mineral in the testing range of pH, all immersed in a temperature-controlled bath. Predetermined amounts of the required test flotation reagents are now stirred into the beaker for the required number of minutes and the test is then made. For many minerals the particles raised on the bubble and drawn into the pick-up tube can be examined wet on the microscope slide, but occasionally it will be necessary to dry them and perhaps determine their refractive index as part of the process of identification or test.

The authors warn the reader that the quantitative pick-up method does not give such good reproducible results as contact angle measurement, but against this observe that if the tests are repeated several times the average result is reliable. They also warn the worker against attempting to work on flocculated particles, which must be broken into smaller flocs by the use of a glass rod before making the bubble pick-up test. The writer of this note considers that the convenience and easily obtained cleanliness of the method makes it superior to contact-angle measurement for the practical work of

[1] *Engg., Min., J.*, May, 1957.

tying particles of ore of flotation size to flotative behaviour and that, properly used, it will rapidly establish the general conditions for flotation. If the work is then followed up by the use of a Hallimond tube it can be checked adequately. There still remains the critical business of completing the tests by flotation in a small laboratory cell in which a proper frothing agent is used and a froth is correctly removed from the top of the newly-constituted mineralized froth column.

Book Reviews

Quin's Metal Handbook, 1956–57. Pocket-size, 704 pages. Price 25s., post free. London: Metal Information Bureau, Ltd.

The latest issue of Quin's Handbook, the 43rd in an unbroken annual sequence, contains, as usual, complete data relating to prices, production, consumption, exports, imports, brands, and stocks of a very wide range of ferrous and non-ferrous metals. To rectify delays in receiving some statistics and the time involved in compilation, typesetting, etc., and production generally, the latest issue is called the 1956–57 edition, but subsequent editions are to carry the year of publication. As an international reference book the present edition is as handy as ever.

Kempe's Engineers Yearbook, 1958. In two volumes in case, 7,000 pages, illustrated. Price 82s. 6d., *plus* 2s. 6d. postage. London: Morgan Brothers (Publishing), Ltd.

Many pages of additional text, as well as fresh illustrations, appear in the latest edition of this standard work of reference for all branches of engineering. It is stated that every section and sub-section of the book has received the attention of a specialist in that field and details of established developments in modern practice are included. The layout of tables and formulae has been improved, where possible, to speed the search for information. This is aided by an index which includes 17,000 references.

☛ Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Engineering Log

Although superficially there appears little connexion between modern industry, the atmosphere, and the little-known slow currents which run in the depths of the oceans, these three are nevertheless inter-related in a complex system which profoundly affects climate and the pattern of the future. The seas provide a colossal system of energy storage and transport, one which balances up the peaks and valleys of atmospheric changes. With the change in the industrial pattern following the exploitation of coal and oil a third modifying factor has been introduced and its incidence is still practically uncharted. One of the tasks during the International Geophysical Year is to shed some light on what is happening. The atmospheric "heat engine" is energized by the sun, some heat being taken up by the air, some reflected back into space, with the bulk spent in heating the lands and oceans. Heat sorption, transfer, and inter-action close to the globe's surface provide the basic changes in weather, but the natural balance has been upset by releasing huge tonnages of carbon dioxide into the air, which lets solar radiation through to the surface but resists re-radiation outward, the result being a small but significant warming-up all over the earth. The immediate need apparently is accurate measurement of the carbon dioxide in the atmosphere on a global scale, in order to trace its movements and changes in concentration.

* * *

A new bearing alloy which contains about 20% of tin, the remainder being aluminium hardened with from 1% to 3% of copper has been brought into production by the Tin Research Institute and a British company. The tin constituent, it is stated, has a structure which is reticular within the continuous aluminium matrix—*i.e.*, a structure continuous without disturbing the continuity of the aluminium. Should metal to metal contact occur between a shaft and a bearing with this reticular structure there is an immediate supply of tin available at the surface to provide a thin soft layer of tin over the aluminium and thus inhibit surface breakdown. The new alloy thus combines the strength of a continuous aluminium phase with the tin-availability of a comparatively heavy and continous tin structure. When supplied in the form of steel-backed

bearings it provides a better balance between the opposing demands of high fatigue strength and low rates of wear than any other known plain bearing.

* * *

The Manufacturing Trust Co. branch bank at 5th Avenue and 43rd Street, New York City, designed in 1953, is a daring departure from the traditional marble exterior. All the work, including what goes on in the bank vault, is visible to anyone passing by. Five stories high, the building measures 125 ft. by 100 ft. and is made up of two open banking floors (the second on a mezzanine set back from the outside walls) and an executive floor. Except for the dark glass spandrels the entire exterior is built of clear glass sheets up to 9-ft. wide by 22-ft. high and ½-in. thick. The spandrels above the ground floor contain mechanical and electrical distribution systems, while the clear glass runs from floor to ceiling. An aluminium rail prevents people from walking into the glass. A continuous shaft space along the south-west and part of the north-east walls handles the ducts, piping, and electrical service. Air conditioning for the building is built on five systems, while to maintain conditions in summer a cold-air duct is kept at about 30° F. below room temperature. The building is heated by two systems of forced hot water, one for the ground to third floors and one for the executive floor.[1]

* * *

A machine has been built by the National Physical Laboratory to calibrate hardness test blocks and so provide a national standard of hardness. The machine is to provide a standard for the Vickers hardness scale, but the eventual goal of the research is to provide a standard also for the Rockwell scale, which is used extensively in industry. When both hardness standards have been achieved they will remove much of the confusion which exists to-day in hardness measurement throughout the world. The N.P.L. machine uses a diamond pyramid which can be loaded with 30 kg., 50 kg., 100 kg., or 120 kg. correct to one part in 30,000 or better. The width of the indentation produced is then measured to better than ten millionths of an inch using a microscope and a specially-designed lighting system. From this, the Diamond Pyramid Number can be calculated. The machine is accurate to ± 5 D.P.N. units. The machine is of a completely novel design, it is stated. Initially the load to be applied rests on a horizontal table with the diamond pyramid rigidly attached to the load and pointing downwards just clear of the specimen. The table is lowered hydraulically until the whole load is suspended on the specimen, the diamond pyramid acting as a single-point " knife-edge ". The load thus hangs in free air and the force applied to the specimen by the diamond is due entirely to the load. By taking special precautions it was ensured that the diamond pyramid remains vertical within 0·3 second of arc, the angle made by two lines drawn from the top and the bottom of a London suburban house to meet in New York. The hydraulic plunger which operates the table is of a unique design as the table has to be lowered without any jerks at a speed of only a thousandth of an inch per second. The machine is being tested for long-term stability to ensure that its readings will not change from year to year.

[1] *Heat., Piping, Air Cond.*, Oct., 1957.

* * *

A helicopter was used recently to erect a spire for a church in Michigan. As the helicopter could lift only a 600-lb. weight the spire was cut into five sections 6½ ft. to 13 ft. long and prepared in the shop for temporary erection bolts and subsequent welding. The sections were hoisted successively in 1¼ hr. of working time and the helicopter was in use from airport to airport for four hours—at $75 per hr. Standard methods of erection would have called for a heavy 190-ft. boom crane which would have constituted a danger to the concrete structure of the church surrounding the tower. The chief purpose of the departure from conventional methods, however, was to discover whether in fact a helicopter and pilot would make an effective part of an erection crew. The pilot achieved his part without difficulty, hovering over the structure and holding the section in position while workers on the tower made it fast. A foreman, two connectors, and two ground men completed the team. As each section was added workers on the tower erected a 5-ft. scaffolding section to raise the working platform, taking about 10 min. each time. A four-point suspension rigging system of 1,000-lb. aviation cable was used with a spring safety hook to hold the load directly below the helicopter's centre of gravity and 10 feet clear. The load

could be released by a line to the erector on the building or by an emergency line running to the pilot. Since the helicopter carried no mirrors signals were given by walkie-talkie instead of by hand. This experiment should open the way for the use of the helicopter as a skyhook, particularly when helicopters with greater lifting capacity are made available.[1]

* * *

Because of their physical properties and biological effects neutrons present a special type of radiation hazard, but the formulation of adequate protection regulations is extremely difficult due to the limited experience available and the variable output of many neutron sources. A new handbook based on what is believed to be the best information presently available has, however, recently been issued by the United States Bureau of Standards.[2] In view of the rapid development of neutron technology it was felt necessary to state recommendations rather than rules in many instances, but rules are given which are deemed essential for proper protection. Other chapters cover the present status of physical and biological information and radiation protection in installation and operation of neutron sources.

* * *

In at least one industry Britain is ahead of the United States in the degree of mechanization—that of Cheddar cheese manufacturing.[3] As a result of the highly-mechanized factories now in use labour costs have been reduced, processing times shortened, and employee morale improved with the lightening of the labour involved. The milk is set with rennet and lactic cultures in large square-ended vats and the curd cut with special knives. Cooked curds and whey are transferred to sinks, where processing continues with pressing under the warm whey and/or cheddaring. Cheddared blocks are then conveyed to machines to be milled and the curds are salted, cooled, and hooped automatically. Since the initial equipment is costly small cheesemaking factories would not find mechanization economic. Where production justifies the expenditure, however, there are distinct advantages. From setting to pressing with the mechanized process takes only 4½ hours as against 5½ to 6½ hours by the conventional method. The use of curd sinks releases the vats two hours sooner for new intake and the comparative shallowness of the sinks enables women to do the cheddaring, since the physical strain is less.

* * *

Anti-smog research carried out by the Ford Motor Co. has revealed a chemical which promises to be useful as an agent for purifying the exhaust gases of motors, it is reported. The chemical is an oxidation catalyst—vanadium pentoxide. Used in the yellow powder form in which it occurs it is said to have effectively eliminated 80% of the offensive hydrocarbons produced by a single-cylinder engine during a laboratory test of 100 hours' duration. The effectiveness is estimated to last for the equivalent of 4,000 miles of driving. The vanadium pentoxide used is a by-product of uranium production and is in excess supply at low cost. It is therefore possible that a device could be manufactured which would be economical to use.[1]

[1] *Civil Engg.*, Dec., 1957.
[2] Washington, D.C.: National Bureau of Standards. Price 40 cents.
[3] *Food Engg.*, Dec., 1957.

Letter to the Editor

Kimberlite Intrusions

SIR,—I would like to congratulate Professor Davidson on his excellent article "The Diamond Fields of Yakutia" in the December issue. I have long speculated about the link between kimberlite on the one hand and dolerite and allied rocks on the other. My supposition is that kimberlite formed in a kind of thwarted geosyncline, where, because of the rigidity of the crust, the initial outpourings of lava and the intrusion of sills and dykes of dolerite were *not* followed by the customary sinking of the surface, incursion of the sea, and cycles of sedimentation. Instead, as the thousands of cubic miles of basis igneous magma welled upwards, so their place was filled by distension of the eclogite-peridotite shell. This distension relieved the pressure on the "dry" shell and raised it into a zone of rocks containing plenty of combined water and oxygen. Consequently, in the course of some millions of years,

[1] *Heat., Piping, Air Cond.*, Oct., 1957.

partial melting took place with hydration of olivine to serpentine, oxidation of graphite to make carbonates, and generation of a kimberlite magma, potentially highly explosive. The magma would contain nodules of unmelted eclogite and peridotite.

My supposition is set down with diffidence in the hope that it may provoke a little discussion. If a regional rise in the eclogite-shell did indeed precede extrusion of kimberlite then in kimberlite country there should be a widespread positive gravity anomaly at depth.

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January 12, 1958.

News Letters

MELBOURNE

January 29.

New South Wales Coal.—The Joint Coal Board has stated that in 1957 the State exported more coal than in any year for 30 years. While this is satisfactory it must be recalled that before that period export of coal was a substantial industry until the trade was destroyed by continuous industrial trouble on the coalfields, which, as well as losing this valuable export trade, lost equally important Australian markets to oil. Despite the competition of alternative fuels—and oil has substantial advantages—coal mining is, perhaps, a little more than holding its own, but if a reasonable policy had been followed by the coal miners in the past the industry would now be in a very solid position to the substantial benefit of the employees themselves.

The Board's report shows that last year's exports were almost three times those of 1956; tonnage exported was 765,000 tons and it is expected that probably as much will be exported in 1958. Destinations of the cargoes are mainly Japan, Korea, and New Caledonia. Export figures are: 1954, 358,000 tons; 1955, 213,000 tons; 1956, 278,000 tons; 1957, 765,000 tons. Modernization and mechanization have been carried out extensively on all coalfields, but more yet remains to be done. The sales position can also be helped by improvement in quality, which is being met by the erection of dense-media washing plants. Another factor of importance is the production of several types of coal to suit the requirements of customers; the practice hitherto has been to produce and market two sizings only, despite the successful experience of one or two pioneers in the marketing of several grades. More attention is now being given to this sales aspect.

The State of New South Wales is well placed in the coal production field. The seams are, for the most part, good and the quality of the coal is high. Working conditions are also good and since the withdrawal by the miners of the embargo on mechanical mining of pillar coal a great part of the very large reserves hitherto locked up in pillars as the result—some 200,000,000 tons of high-grade coal—are now available and costs can be materially reduced.

New Guinea.—A report recently issued states that the future of mining in New Guinea is not promising and that the only locality where there is any pronounced activity is at Wau, Edie Creek, where about 200 men are working at three areas. New Guinea Goldfields has turned its attention to other interests because of the absence of quantities of commercial minerals, these interests including timber, copra, and coffee.

Much of New Guinea has not been mineralogically explored and such work is now being carried out in the highlands by the Mines Department. This work has been in progress for a number of months, for the position has been receiving the attention of the Administration for some time. With the depletion of its reserves of gravel Bulolo Gold Dredging has done considerable prospecting, but results do not seem encouraging; timber has been taken up as a promising enterprise, its main direction being the production of plywood.

The Bulolo company is now nearing the end of its career. For the greater part of its life it worked eight bucket dredges, but only one is now operating. There are still reserves of gravel, but material immediately ahead of the dredge is low grade. Several years' work is still ahead of this plant and there are fairly substantial areas of ground to be worked by hydraulic sluicing. The company has advised that a fall of 74% in the profits can be expected from dredging and sluicing operations in the current year. During the past financial year 1,282,000 cu. yd. of ground were treated as compared with 2,122,000 cu. yd. in the previous year.

Western Australia.—In the financial year to March 19, 1957, the ore reserves in the North Kalgoorlie (1912) mines in Western Australia were increased by 27,000 tons to a total of 2,244,482 tons, with an average grade of 5·38 dwt. gold per ton. The reserves comprise 1,679,101 tons of positive ore averaging 5·40 dwt. and 565,381 tons of probable ore with an average grade of 5·31 dwt. There was a slight decrease in costs (from 57·9s. per ton to 57·6s. per ton) which is creditable in the face of the continued upward trend in the costs of labour and stores; significant moves were an increase of 2·4s. per ton in mining costs and a fall of 2·7s. in milling costs. There has been improvement in the percentage of payable ore developed and the tonnage position has also been improved by increased stope widths and extensions of some of the larger stopes. During the year production was 344,630 tons of ore from which 87,925 oz. of gold were recovered; average head value was 5·103 dwt. gold. There seems every reason to expect a continuance of the development results of the past year. In comparison with the neighbouring mines of the Golden Mile the workings of North Kalgurli are relatively shallow and all lodes offer attractive scope for exploration at greater depth.

Developments in Great Boulder Gold Mines, Kalgoorlie, and Central Norseman Gold Corporation, Norseman, continue to be satisfactory and interesting. At Great Boulder in the 12 weeks to November 26, 1957, 3,472 ft. of development work was completed of which 31·3% was in ore of 4-dwt. grade or better. Central Norseman Gold Corporation in the period ended December 24 had values in the No. 14 level of the Crown reef of 5·8 dwt. over 49 in. for a length of 99 ft. and at No. 16 level 38 ft. was in ore worth 13·3 dwt. over 48 in.

The State's gold production for the first 11 months of 1957 was 32,000 oz. higher than for the corresponding 11 months of the previous year. November production was 65,700 fine oz., which return carried the production for the 11 months to a total of 747,349·99 fine oz. The total gold produced in Western Australia to November 30, 1957, is now 58,928,816 fine oz. The increase in output is very encouraging in view of the prevailing adverse conditions, but it is still to be regretted that the industry depends upon old mines without assistance from new discoveries. There is no incentive to large-scale exploration by other than Western Mining Corporation, although there seems to be an increase in activity by prospectors and working parties.

Some encouraging development results in Sons of Gwalia mine are reported, but much work continues to be in low-grade material. In the period to November 26, 1957, the most interesting development work was at the No. 26 level where a rise had been advanced 48 ft. in values of 20·9 dwt. over a width of 72 in. No. 2 north drive on this level was in ore assaying 9·4 dwt. over 96 in. Cross-cutting on No. 24 level had passed through 3 ft. of ore assaying 22·4 dwt. and 4 ft. assaying 10·1 dwt. On other levels values were low. Diamond-drill results made low-value intersections during the period.

Emperor Gold.—There has been some disappointment expressed over progress at Emperor Gold Mines, in Fiji, where developments laterally and at depth had raised hopes of an expansion in operations. However, the mine position is satisfactory and developments seem to have been satisfactory generally and to warrant the hopes of shareholders. It is probable that new money will be needed to provide additional mining and power equipment and to finance alterations to the mill to carry out the planned increase in production and to speed up underground development.

King Island Scheelite.—This large company, working on King Island, Tasmania, has maintained its dividend despite the depressed price for tungsten. The company's contract with the United States Government has been largely responsible for this position, but the contract will expire in April, when all production will have to be sold on the open market. Costs are being reduced as far as possible and the mine will be placed on a five-day working week, thus obviating the payment of penalty rates for wages for Saturday and Sunday work. The penalty rate for work on these days applies despite the rostering of employees and the maximum working week of 40 hours. Profit earned by King Island Scheelite in the year to October 31, 1956, was a record, ore milled in that year being 265,919 tons and value of output £2,486,845. Profit for the year just ended has not been announced, but the tonnage of ore mined totalled 264,588 tons with the lower value of £A1,881,839. Concentrates produced amounted to 1,437 tons, which was 84 tons less than in the previous period. The mine is worked by open-cut and is well and efficiently equipped.

New Occidental Gold Mines.—This once-large gold producer in the Cobar, New South Wales, district is to be wound up. In a period of 24 years the company treated 3,276,973 tons of ore, made a net profit of £A1,377,817 to June 3, 1951, and distributed £A1,301,533 in dividends. The company has transferred its leases to two companies—Cobar Mines Pty., Ltd., and Cobar South Pty., Ltd.—offshoots of Broken Hill South, Ltd. The leases are being examined by the new operators; it is believed that there are considerable tonnages of copper ore, containing gold, but the heavy fall in the price of copper has altered the position since the leases were acquired from New Occidental. Exploratory work is being pushed on rapidly despite the changed circumstances.

Tasmania.—It has been stated by the Minister for Mines in Tasmania that the Savage River iron-ore deposits, west of Mount Bischoff, are the best mining prospect for 60 years. Drilling is in progress and the first bore has reached a depth of 668 ft.; the deposit is said to have substantial dimensions and assays of the ore are considered to be very satisfactory. Width of the iron occurrence is put at 200 ft. and it has strong continuity to a depth of 500 ft. It is not yet known if the ore contains impurities that will adversely affect the manufacture of iron. The deposit has been known for over 60 years and has been superficially examined by mainland iron-ore interests as well as by technical officers of the Tasmanian Mines Department, but the present drilling is the first that has been done on the occurrence. Hitherto, apart from the quality of the ore, no Tasmanian deposit has given promise of sufficient tonnage to form a commercial undertaking.

Barytes.—South Australia has a leading position as a producer of industrial minerals, a number of which are widely distributed in the State. A successful venture is the mining of barytes in the Flinders Ranges, which has so increased in importance that the company has recently built a new and larger treatment plant at Quorn, near Port Augusta. Production is at the rate of about 500 tons of barytes per four-weekly period.

Bauxite.—The very large discovery of bauxite on Cape York Peninsula by the Zinc Corporation group has led to the entry into the field of overseas aluminium interests. A Canadian company, Aluminium Laboratories, Ltd., a subsidiary of Aluminium, Ltd., was very early in the vicinity of the Zinc Corporation discovery and has been prospecting during 1957. It is now reported that new bauxite areas, believed to be an extension of the original discovery at Weipa have been made. This exploratory work is said to have cost £A200,000 to date.

The original discovery at Weipa is being developed by Commonwealth Aluminium Corporation Pty., Ltd., which is jointly owned by Consolidated Zinc Corporation, Ltd., and British Aluminium Co., Ltd. Problems ahead of the corporation are harbour construction, water supply, township, as well as the industrial plant and equipment. Other problems to be met will include employee moral and productivity in an isolated environment in which climate is an important factor. Development of a cheap source of power is an important essential and the natural conditions of the region are definitely unfavourable. Factors such as isolation and climate can be countered, as has been done at Cockatoo Island in Yampi Sound, Western Australia, by Australian Iron and Steel, Ltd., the subsidiary of the Broken Hill Proprietary Company which is supplying a large tonnage of high grade iron-ore to the works on the east cost of Australia.

SINGAPORE

January 1.

Land Rehabilitation.—To rehabilitate land where tin mining has finished in Malaya, payment by mining companies into a cess has recently been proposed. Some years ago a grant was made from Colonial Development and Welfare funds for research into means of rehabilitating such land and work started in full at the end of 1954. Worked out areas include gravel pump and old lampan tailings and uncontrolled dredge tailings and it was estimated that about one-half to two-thirds of such areas in Malaya could be revegetated or planted up with some hope of success without major earth-moving and drainage control schemes. The remainder was considered unplantable without excessively heavy manuring or carefully planned earth-moving, drainage, and river control. Worked-out areas where dumping had been carefully controlled—such as, the majority of dredge tailings and some gravel-pump tailings—were an easier prospect for rehabilitation by afforestation, but costs are likely to be high

since such tailings also encourage heavy natural vegetation. The question of raising funds for rehabilitating such areas where mining had finished and in many cases the leases had expired " would seem to call for payment into a cess by existing mining companies, funds deriving therefrom being used as and where necessary."

Development Plans.—The importance of the Geological Survey to Malaya's development was emphasized in the Legislative Council when Inche Bahaman bin Shamsudin, the Minister for Natural Resources, presented his (Malayan) $11,630,834 Budget, which was approved. This money, he said, would be used to improve and speed up land development. He also said there would be additional research staff for the Department of Mines and a Land Council is to be established.

Sir Abu Bakar, the Sultan of Pahang, told a Budget meeting of the Pahang Council of State that plans were afoot to develop the State's natural resources with a view to increasing income. Several areas had been earmarked for development but shortage of staff had been the major problem, while land and mining policy were due for overhaul.

Mr. Ivan Spens, chairman of the London Tin Corporation, said in Malaya recently that the Corporation had every confidence in the future of independent Malaya. He is quoted as saying : " We are very impressed by the way the Government is running this country and we think there is a bright future. We have the capital and are prepared to invest it here. We would like to open more tin mines in Malaya if the Government is prepared to give us more new land." Dredges of Anglo-Oriental (Malaya), Ltd., would also need new land when they had exhausted their present sites.

The Selangor State Government has been urged by the Selangor State Ketua Kampong Association to help Malays revive their mining interests. In a memorandum to the State Government the Association asked for more mining licences to be issued to Malays and for every assistance to be made to Malays in the independent Malaya to open up new mining areas.

Mine Employment.—A four-man working party has been set up by the Federation of Malaya Government to investigate the present unemployment crisis in the country's tin mines following cuts in production imposed through the International Tin Agreement. The party comprises representatives from four ministries—those dealing with labour and social welfare, commerce and industry, natural resources, and finance. Meanwhile Federation tin producers have been told that from the beginning of this year they would have to start paying the Government the (Malayan) $12,000,000 it had sent to the buffer stock. Hardest hit are Malaya's 500 Chinese tin-mine owners. Some have been planning a grouping system in order to cut costs.

As a result of the decision to cut production in order to stabilize the world price of this commodity Malaya's production will be reduced by about 30%. In the first three quarters of 1957 Malayan mines produced an average of 14,675 tons of tin ; exports for the controlled period of three months until March 14, 1958, will be limited to 10,125 tons. Arising from this it is feared that a number of small mines will be forced to close down. Mr. A. J. D. C. Loch, secretary to the Minister for Commerce and Industry, said the Tin Council's action was for the benefit of tin producers. When Malaya decided to support the council it was accepted that one day this situation would arise.

Indonesian Tin.—The Indonesian Government plans to send a mining official to Singapore for talks on the possibility of smelting its ore in the colony, according to the Trade Commissioner. Tin is said to be piling up at Tanjong Priok, the port for Jakarta and on the tin-producing island of Banka, off Sumatra, because of the Indonesian Government's seizure of the K.P.M. Dutch inter-island fleet.

Coal Mining.—Mr. J. Drysdale, chairman of Malayan Collieries, Ltd., said in his annual report that unless more support was forthcoming by users of fuel operations at the Batu Arang coal mine would be further curtailed and eventually closed down. He had pointed out to the Government that the coal-mining industry was a national fuel resource and that Malayan Collieries, as an employer, supported a township of about 6,000 people. Unfortunately, however, the Government did not seem to be interested. Demand for coal by Malayan railway and power stations continued to decline, the average monthly coal demand for the year to June 30 last being 14,850 tons as compared with 16,080 during the previous year and 10,700 tons a month for the first four or five months of the current financial year.

Iron.—A mine which is expected to ship 350,000 tons of iron ore annually has now

been officially opened at Temangan in Kelantan by the Oriental Mining Co., Ltd. The mine was operated before the war when it was a Japanese concern. It was closed in 1941 and remained derelict until prospecting recommenced in 1954 following Japanese interest through the Kokan Mining Co., Ltd. Oriental Mining was eventually formed with the original partners as shareholders and the Kelantan State Government also decided to take part to turn the firm into an international one with Malayan, British, and Japanese capital.

Japan, to keep pace with its industrial expansion, is to continue to buy increased quantities of iron ore, bauxite, and iron and steel scrap from Malaya a spokesman of the Japanese Consulate-General in Singapore said recently. Japan's purchases of iron ore, bauxite, and iron and steel scrap from Malaya now total hundreds of thousands of tons a month.

Brunei.—Production of light and heavy crude oil from Seria field (including some 600,000 barrels of gasoline from the gas plant) by the British Malayan Petroleum Co., Ltd., amounted in 1956 to about 42,000,000 barrels ; this is about 3,000,000 barrels more than in 1955. A total of 230,900 ft. of hole was drilled in the Seria field (compared with 209,900 ft. in 1955) and 36 new wells were completed as oil producers.

Sarawak Oilfields, Ltd., has decided to surrender over three-quarters of its oil mining leases, mainly in the interior of Sarawak. About 36,650 square miles was to be surrendered at the end of 1957. The company would retain some 10,850 square miles, mainly in the coastal areas where the search for oil is continuing. Since the end of the war this search has involved an expenditure of some £8,800,000.

VANCOUVER

January 6.

Mineral Production.—The Hon. W. K. Kiernan, Minister of Mines, has forecast a decline in the value of mineral production in British Columbia of approximately $25,000,000 in the year 1957. The estimated figure for the year's output is $165,000,000, which compares with the actual value of $190,084,643 in 1956. The Minister's forecast gives the following estimated figures, with actual 1956 figures in brackets, for the major items and for groups of minor items :

Gold, lode and placer, $7,275,000 ($6,713,078) ; silver, $7,000,000 ($7,511,443) ; copper, $7,600,000 ($17,251,872) ; lead, $39,150,000 ($44,702,619) ; zinc, $48,100,000 ($58,934,801) ; iron and tungsten, $7,900,000 ($8,542,223) ; by-product metals, including antimony, bismuth, cadmium, indium, and tin, $5,600,000 ($5,784,787) ; industrial minerals, including asbestos, gypsum, sulphur, and others, $12,400,000 ($10,390,338) ; structural materials, including clay products, lime, limestone and cement, rock and building stone, sand and gravel, $21,400,000 ($20,587,159) ; coal, $7,750,000 ($9,346,518) ; petroleum and natural gas, $950,000 ($319,805).

In a brief analysis of the estimated value of production and the underlying causes for the decline, Mr. Kiernan states :

Output of lode gold increased in 1957 reflecting increased output in the Bridge River area that more than offsets the reduction in gold produced as a by-product in the mining of copper, lead, and zinc. Output of silver, lead, and zinc declined moderately in quantity ; the decline in value is mainly because of reduced prices. Copper output declined by a third from the 1956 quantity and the value fell to less than half that of 1956, reflecting the marked decline in the price of the metal, which began in 1956 and continued through 1957. Metals had a combined value of $122,400,000 compared with $149,400,000 for 1956. The 1957 metal output, valued at prices of 10th December, would have been only $112,250,000, some $10,000,000 less than the valuation using average prices for the year.

Output of industrial minerals increased because of greater production of asbestos and sulphur. Increased output of Portland cement was the main factor in the moderate increase in the 1957 value for structural materials. Petroleum production is still on a modest scale but 1957 shows a considerable increase over 1956. Output of natural gas is materially increased, although the increased rate came into effect late in the year following completion of a gas-cleaning plant and of pipelines to convey gas from north-eastern British Columbia to markets in southern British Columbia and in the United States.

Liard.—The annual report of the Cassiar Asbestos Corporation for the year ended September 30, 1957, indicates a very successful operation. Revenue of $8,314,620 was obtained from the sale of asbestos fibre, the direct operating cost including $2,881,763 for mining and milling and $1,600,496 for shipping and marketing ; general and administrative expense was $120,431. After the provision of $862,419 for depreciation and $38,216 for amortization of exploration and development the net profit for the year was $2,811,295, the earned surplus at the year-end standing at $6,094,885. The company reported current assets of $4,571,341, against liabilities of $986,770. During the 1957 mining season, which extended from March 20 to November 7, 414,827 tons of ore and 876,349 tons of waste were mined and moved.

The addition of two shovels and six 24-ton trucks to the mining equipment greatly facilitated the movement of both ore and waste. Good progress was made in the removal of waste from the hanging-wall of the ore-body and sufficient ore for the 1958 mill requirements is stripped and available for mining. The mill treated 382,186 tons of ore for an average of 1,045 tons per calendar day with a fibre recovery valued at $22·41 per ton. Four grades of spinning fibre and four grades of cement and shingle fibre are now being produced. The sale of spinning fibre remained steady throughout the year and there was a marked increase in the sale of asbestos cement fibres. A price increase of 5% on all grades was made effective October 1, 1957. It is anticipated the volume of sales for 1958 will remain at about the same level.

Cassiar Asbestos has an option to purchase all rights and interests of Conwest Exploration Co., Ltd., in three asbestos properties (the Letain, the Caley, and the Clinton Creek). Initial development work by Conwest had indicated important showings of asbestos ore on each property. The amount expended to the year-end on this project was $229,398, including the initial option payment of $100,000, the cost of the examination of the properties by independent geologists and the camps, equipment, and exploration charges at the Clinton Creek property. The ore-body at Clinton Creek is being developed by open-cuts and by two adits. Mill tests of the ore are to be made during the current year. The Clinton Creek and Caley properties are in Yukon, approximately 40 miles north-west of Dawson, and the Letain property is in British Columbia, approximately 60 miles south-east of Cassiar. Cassiar asebestos is to maintain an active exploration department to explore for and acquire asbestos properties of merit in the area.

Omineca.—Shareholders of Ingenika Mines, Ltd., have been advised that the Consolidated Mining and Smelting Co. of Canada, Ltd., has spent more than the $35,000 minimum required in 1957 under its option agreement to explore the Ingenika holdings, 45 miles from Fort Grahame. Cominco put in 28 diamond-drill holes for a total of 10,718 ft. in areas adjacent to the old mine workings, but, with the exception of one hole driven through the known zone, all others proved to contain only minor mineralization. Despite the disappointing results there is a quantity of good indicated ore partly proved. If the Wenner-Gren interests provide the transportation mooted for the Rocky Mountain Trench it is entirely possible, Mr. B. A. Wilson (the Ingenika president) notes, that a small-scale operation may be conducted profitably. At the end of 1957 Cominco had given no indication of its plans for 1958. Of the authorized capital of Ingenika Mines, Ltd., of 3,000,000 shares 1,377,300 are now outstanding.

The annual report of Sil-Van Mines, Ltd., for the year ended November 30, 1957, reveals that all work was suspended in September last when it became impractical to proceed with production plans in the face of continually declining base-metal prices. Recent underground drilling had added to the reserves some 40,000 tons grading 0·037 oz. of gold and 2·5 oz. of silver per ton, with 6·74% zinc and 0·43% copper, but this material must now be considered sub-marginal. It is proposed to resume diamond drilling in 1958 with a view to determining the southern extension of the Mamie shear zone, the northern extension of the Canary zone, and to explore the Silver Lake and Silver Creek zones. At November 30 last the company had working capital of $113,614 after development expenditures of $133,444.

Victoria.—The annual meeting of Cowichan Copper was informed by the company President, Mr. O. G. MacDonald, that the company's mill was now performing satisfactorily and treating about 500 tons of ore daily. Provision is at present being made to increase capacity to 1,000 tons daily and when this is accomplished the company will treat 700 tons of its own (Blue Grouse) ore and 300 tons of custom-shipped consignments from other Vancouver Island properties. He said the contract with Japanese purchasers will mean $1·00 per ton greater net revenue than would be obtainable from North American smelters. The concentrate purchasers—Sumitomo Shoji Kaisha, Ltd., and Daiichi Bussan Kaisha, Ltd.—have agreed to advance the cost of wharf construction and to make major payments as concentrate is stockpiled in advance of shipment, as the smelters in Japan will not be in a position to accept deliveries before June, 1958. The Cowichan contract is firm for all deliveries that can be made within a three-year period following commencement of shipping. The balance sheet at May 31, 1957, shows current assets of $171,299, against liabilities of $52,281.

Kamloops.—Particularly encouraging re-

sults have attended recent diamond drilling on the westerly extension of the copper-magnetite ore-body of Craigmont Mines. The work is being done by Canadian Exploration, Ltd., under an option agreement. It is expected that an estimate, to be prepared soon, will disclose impressive reserves. The annual report of Craigmont shows current assets of $85,796, against liabilities of $37.

Nelson.—Canadian Exploration, Ltd., has reported estimated gross operating profit of $1,621,000 in the three-month period ended October 31, 1957, during which 8,389 tons of lead and zinc concentrates were recovered from 113,019 tons of ore grading 1·27% lead and 3·93% zinc treated in the lead-zinc mill; 25,856 units of WO_3 were also recovered from the 43,393 tons of ore treated in the tungsten mill. The period represents the second quarter in the company's fiscal year.

Slocan.—Blue Star Mines has been incorporated to acquire and develop 23 mineral claims comprising the former Wellington mine at Retallack. The company has also purchased the camp buildings and remaining plant of Kootenay Belle Gold Mines at the Whitewater camp, which adjoins the Blue Star holdings. The company is capitalized at 3,000,000 shares of a par of 50 cents each, of which 750,000 shares have been issued for properties, 100,000 shares sold for cash, and 70,000 shares issued to pay for the complete mining plant of Silver Hill Mines, which is being moved to the Slocan property. The new company proposes an energetic underground development.

Golden.—Sheep Creek Mines earned an operating profit of $26 in the six months to November 30, 1957, which compares with $24,539 in the comparable period of the previous fiscal year; the decline is due entirely to lower base-metal prices. Increased tonnage and an improvement in grade made it possible to operate without loss during the period just concluded.

Yukon.—The November production of the Yukon Consolidated Gold Corporation, Ltd., had an estimated value of $183,000, bringing the year's aggregate to $1,886,000, which compares with $1,605,000 for the year 1956. Exceptionally favourable weather permitted dredging operations to continue to a much later date than usual. The final dredging operation was closed on November 27, when dredge No. 11 ceased mining on Hunker Creek.

TORONTO

January 27.

Bancroft Area.—A 1,000-ft. three compartment shaft has been completed by Canadian Dyno Mines and the 180-ft., 330-ft., and 480-ft. levels prepared for stoping. The mill installations are approaching completion and it is hoped that this third producer in the area will soon reach the production stage. The ore reserves on the property have been estimated as 2,250,000 tons averaging 0·093% uranium oxide.

Manitoba.—The Hudson Bay Mining and Smelting Co. reports a profit of $6,669,950 for the first nine months of 1957, which compares with $17,038,794 for the comparable period of 1956. The output for the 1957 period was valued at $32,102,819. At Snow Lake shaft sinking is in progress and it is hoped to start work on the new railway to the area in the current year.

A profit of $1,515,592 for the third quarter of 1957 is reported by Sherritt Gordon Mines. Sales of metals and other products totalled $5,677,666. Sinking of the Farlay shaft at Lynn Lake was continued in the quarter.

Saskatchewan.—At Lake Cinch Mines, which is now sending some 150 tons of ore daily to the Lorado customs mill in the Beaverlodge area, the shaft has been deepened to below 850 ft. and two new levels opened at 625 ft. and 750 ft. In October last 3,037 tons of ore was shipped for treatment.

Two additional levels are planned at Rix-Athabasca Uranium Mines, where the Smitty shaft has been deepened. Thereafter it is hoped to increase production to about 100 tons daily. In the six months to September 30 last, during which 24,207 tons of ore was shipped to Eldorado Mining and Refining, an operating profit of $263,878 was earned.

Gunnar Mines production for the third quarter of 1957 was valued at $4,983,239, the operating profit being given as $3,338,770. The expanded mill is now operating at full capacity, it is stated.

North West Territories.—In the nine months to September 30 last Consolidated Discovery Yellowknife Mines treated 38,214 tons of ore and recovered 61,398 oz. of gold. Development below 2,000 ft. is reported as yielding "excellent grade" ore but over narrower widths. The proved reserves are valued at $8,300,000.

An output valued at $470,000 is reported by Rayrock Mines for the September quarter of 1957, in which period 11,840 tons of ore was treated. The present daily mill rate of 100 tons is to be raised to 150 tons once sufficient ore reserves have been established. Diamond drilling to the 625-ft. level is reported promising.

Quebec.—The September gold output from Quebec mines is reported as 85,547 oz., which brings the total for the first nine months of 1957 to 752,000 oz. The silver output for September is given as 319,278 oz. and that for the nine months as 2,745,287 oz.

It is expected that operations at the property of the Merrill Island Mining Corporation in the Chibougamau area will start in the near future. Plant construction and mine preparation are reported as up to schedule. Ore reserves are given as 1,336,520 tons averaging 2·2% copper with 0·4 oz. of silver and 0·01 oz. of gold per ton.

A decision to cut back primary aluminium production at its Canadian smelters to approximately 80% of total rated capacity was announced on January 22 by Aluminium, Ltd.; recent operating rate has been about 90%. The company said that its principal operating subsidiary—the Aluminum Co. of Canada, Ltd.—would curtail operations at its Arvida and Shawinigan works by closing down about 60,000 tons of annual smelter capacity in the two plants; the company's smelter at Kitimat, B.C., is at present operating below capacity.

JOHANNESBURG

January 29.

Gold Industry.—The committee of the Johannesburg municipality investigating the future development of Johannesburg has reported that by 1966 gold output on the Witwatersrand will decline from about 8,700,000 oz. a year to 3,500,000 oz.; the European and non-European complements will respectively decline from 32,013 and 228,479 to 24,000 and 101,000; at 1956 rates and prices, salaries and wages paid will recede from £44,162,000 to £21,196,000, with the European wage-bill expected to fall by 25% and the non-European counterpart by 55%. These figures are subject to the conditions that the gold price will not materially change and that there will be no substantial deep-level development other than that on the Far West Rand.

Transvaal.—South African Coal Estates (Witbank), Ltd., has two markets for its sales output—the open market and the South African Iron and Steel Industrial Corporation, which purchases blend-coking and steam or industrial coal. The section producing the blend-coking coal operates two independent incline shafts, each serving a different seam, the combination of which in controlled proportions is the blend-coking product. Treatment of the run-of-mine coal is effected in a double-stage washing plant, which produces the blend coal, steam, or industrial coal middlings for sale, and discard or waste. By 1960 extension of operations in this section will raise sales output of the blend coal to 660,000 tons a year and of the middlings to an estimated 225,900 tons, from current sales output of 171,146 tons of middlings and 500,000 tons of blend coal. The company planned to bring a third section into production at an estimated cost of about £750,000 by about mid-1959. However, revised estimates have indicated that existing output capacity should cover probable commitments to mid-1960. Accordingly the commissioning of the new section has been deferred a year, which will enable the company to cover costs of opening the new section, which are now re-estimated as exceeding the estimate, from its own resources and only short-term borrowing. Then, depending on profit margins, it should be possible simultaneously to maintain the current dividend rate. Rising costs, narrowing profit margins and rail transport restrictions are the company's main problems. The company has extended its holdings in the Middelburg, Springs, and Witbank districts and holds about 11,581 acres of freehold, 7,299 acres of mineral rights, and 26,728 acres of mineral leases.

Munnik Myburgh Chrysotile Asbestos is continuing exploratory development to determine the influence of the major downthrow fault on the fibre reserves at depth and, pending further disclosures, shareholders have been warned to adopt a conservative view of the mine's future. Considerable mining difficulties in one shaft area have caused a re-orientation of operations to the other shaft, with satisfactory results reported. Fibre production in the 1956–57 year represented a recovery of 7·98%, against 10·48% previously, the decline being due to mining a lower grade and, in the case of grade-4 fibre output, by a stricter control of the dust content to comply with customer specifica-

tions; the mine also produces grades 6 and 7. With new outlets being unfolded for asbestos, including its use as insulating material in nuclear plants, the long-term outlook for South African asbestos producers is hopeful and profitability satisfactory, providing costs can be controlled. The company's profits have been low in relation to its capitalization and were reduced slightly last year.

New Pioneer Central Rand Gold Mining which has substantial shareholdings in the Stilfontein, Hartebeestfontein, and Buffelsfontein companies has accepted a sub-participation of 25·5% in the prospecting programme being conducted by the Anglo-Transvaal group (through the Middle Witwatersrand company) in an area of about 40,500 claims abutting on the eastern boundary of the Hartebeestfontein lease area; drilling proceeds.

Rustenburg Platinum Mines reports that in the first four months of the current financial year since August 31, 1957, platinum sales by the company represented a little more than 50% of the average monthly sales in the 1956–57 year.

Orange Free State.—With production now having been in progress for two years a review of the operations of Free State Geduld Mines shows that milling has been increased from an initial rate of about 35,000 tons a month to about 63,000 tons and the yield built from about 6·7 dwt. to 14·14 dwt. a ton in the final 1957 quarter, the latter being achieved as the extension of operations underground effected a better balance in stoping and development in the two shaft areas and as development ore tonnage in the mill feed has been reduced. Development and drilling has somewhat clarified the geological and fault structure in the No. 1 Shaft area, especially in the north-east and south-west, but the formations south and east of the shaft remain obscure, necessitating cross-cutting in country-rock and drilling to locate the reef horizon. These operations will continue until adequate information about the major fault makes the formulation of a comprehensive development programme possible. The northerly development has disclosed relative freedom from faulting and water but lower reef values with rapid deterioration of these north and west of the shaft. In the No. 2 Shaft area reef development has been advanced west and south of the shaft with all the main headings having now been advanced through the major east-west water and fault zone a few hundred feet south of the shaft. Ventilation, however, has been a problem in opening up and stoping operations. It has therefore been decided to raise the ventilation flow by 70% by sinking an 18 ft. diameter upcast shaft 800 ft. west of No. 2, which will be completely converted to a downcast system. The cyanide or treatment section capacity of the reduction plant is being increased by 25,000 tons a month to 125,000, the same as the existing mill capacity. Drilling in and close to the lease area of 6,559 claims, including those recently acquired from Freddies Consolidated to the north, indicated average Basal Reef values of about 44·3 dwt. over 46·95 in., including the rich Geduld strikes. Reducing the Geduld bore-hole values arbitrarily to 2,000 in.-dwt. each, the indicated average grade is decreased to about 10·47 dwt. over the same width, which is considerably below reef development values disclosed to date but which includes the lower-grade northern claims where reef development has been nil.

President Brand Gold Mining has now progressed well into what may be described as the second phase of opening up and developing its lease area. This phase will provide additional facilities for extending development in the southern No. 2 Shaft area and, in view of the high temperature gradient, for increasing the ventilation flow in both shaft areas. A major downthrow fault in the No. 2 Shaft area has necessitated the sinking of the twin No. 2 Sub-vertical Shaft system which will provide access to the ore-body below the vertical shaft component down to a depth of about 7,000 ft. from surface. Of the twin sub-vertical system the ventilation component has been completed to a final depth of 2,530 ft. below collar and sinking the hoisting component is now in progress, 562 ft. having been completed to December 31 last. The No. 2 Vertical shaft is being converted into a twin-system, with the existing hoisting shaft being converted completely into a downcast unit and a ventilation component being sunk in its vicinity in a programme aiming at completion of sinking coincidently with the completion of the sub-vertical hoisting component by about the end of 1958. These facilities will give a better balance of mining ore between the Nos. 2 and 1 Shaft systems and make possible the building up of the milling rate from the current level of about 69,000 tons a month to 100,000 tons. However, the average grade in the No. 2 Shaft area

is estimated to be lower than that of the No. 1 Shaft area, whence most of the stoped ore has so far been drawn but the consequent reduction in the mill grade is expected to be relatively slight and counterbalanced by the higher treatment rate. The third phase of opening up the lease area can be said to consist in developing the south-eastern section where the ore-body has been upcast by another major fault. For this purpose a joint twin-shaft system will be sunk, according to plans proposed, with the President Steyn Company.

President Steyn Gold Mining has completed and commissioned a waste-sorting and reef-picking section in its reduction plant, the effective capacity of which has been thereby increased. The gold and uranium grade of the mill feed has also thereby been beneficiated and the company's apportionment of the treatment capacities of the joint uranium plants, one on its own property and the other at Welkom, correspondingly increased. In due course the sorting rate will be advanced to 10% of the reduction plant feed, which may be increased to about 110,000 tons a month this year from the current rate of a little more than 90,000 tons. The ventilation facilities of the No. 2 Shaft are too remote and inadequate to permit the opening up of the south-western section of the lease area. Accordingly it is proposed to sink in due course a joint twin-shaft system to open up that section with President Brand.

Operations by Western Holdings are being conducted with three main objectives in view—completion of the No. 3 twin-shaft system, which should be effected by the mid-year, and the initiation of development in the upcast western section; expanding the reduction plant capacity from 125,000 tons to 150,000 tons a month from the year-end to handle ore from the western section; extending development and mining operations west of the two existing shafts and between them, where faulting has been clarified and found to be less serious than expected in the upper levels, and advancing further to the eastern boundary (common with Welkom) the two twin exploratory cross-cuts which have already passed through the major fault system there and are being carried further to intersect the unthrown reef beyond the fault. Between the line of the two shafts and the fault mentioned indications are that a comparatively unbroken area of ore-body extends down to the 5,000-ft. elevation which will be opened up from sub-incline shafts to be sunk from points adjacent to the existing main shafts.

Welkom Gold Mining is deepening its No. 1 Shaft another 300 ft. approximately and is preparing to deepen No. 2. This will provide additional development faces and thereby facilitate increased development footages; the lack of sufficient faces has recently held back the development rate, especially in periods of delay when water-fissures required cementation. The 18 ft. diameter ventilation component of the joint No. 3 twin-shaft system has been completed; the 24 ft. diameter hoisting component should be completed by about September. Thereafter, the south-western section will be developed and should contribute a small tonnage to the mill feed by the year-end.

Natal.—Late last year Dundee Anthracite acquired from Spiesdale Investments (Pty.), Ltd., all the issued shares of Carnarvon Anthracite Coal Mines, Ltd., for £220,000 which was converted into 5s. shares in the Dundee Anthracite Company. The property extends over 5,170 acres, of which about 4,000 acres are underlain by two seams of anthracite coal at shallow depth adjacent to the main Johannesburg–Durban rail-line near Hattinghspruit Siding. Production has been in progress for nearly four years but present output is only about half the plant capacity of 10,000 tons to 12,000 tons a month due to rail transport restrictions. It is intended that this will be raised to 15,000 tons monthly initially and a washing section added.

Tati Goldfields has sold its coal options and prospecting contracts in the Wakkerstroom–Utrecht area; has been refunded all costs and expenses in connexion with these contracts, and, in the event of exploitation, will receive royalties on coal sales, 10% subscription rights, and 10% underwriting rights in any company formed to exploit the holding.

Cape Province.—Consolidated African Mines has concluded the merging with it of a number of small manganese producers in the Postmasburg area of the Northern Cape. For the consideration of about £75,000 converted into shares the company has, *inter alia*, acquired mineral and mining rights over two properties; machinery, plant, and stock thereon; rights to a truck allocation for 1,000 tons a month under a royalty agreement with another company, and the total issued share capitals of five other companies.

Trade Notes

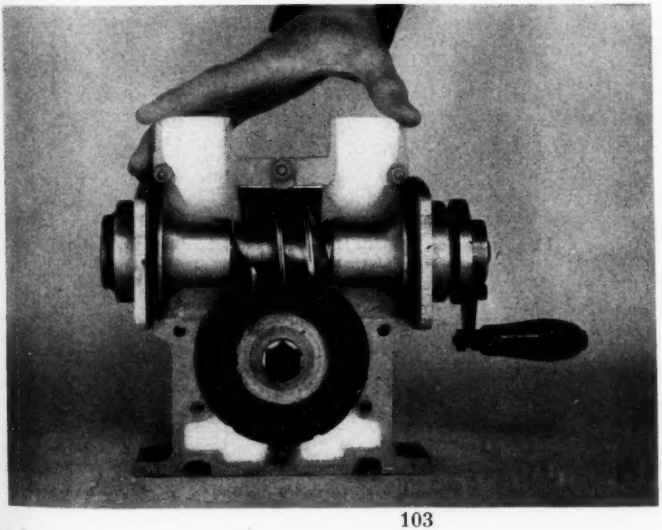
Brief descriptions of developments of interest to the mining engineer

Goodyear Pump

At a demonstration in London last month **Goodyear Pumps, Ltd.,** a subsidiary of **Holman Bros., Ltd.,** of Camborne, introduced their new all-purpose unit, which is made in three sizes ($1\frac{1}{4}$ in., $1\frac{1}{2}$ in., and $2\frac{1}{2}$ in. suction and delivery connexions) requiring prime movers of from $\frac{1}{3}$ to 16 b.h.p. to cover a range of outputs from $4\frac{1}{2}$ to 167 gal. per min. against heads of from 50 to 200 ft. The $1\frac{1}{2}$-in. pump, weighing only 11 lb. and 8 in. by 4 in. by 9 in. in size can at 3,000 r.p.m. deliver 31 gal. per min. against a 200-ft. head and requires a prime mover of 3·1 b.h.p. only. This represents a 61% efficiency.

The new pump is a continuous, self-priming, self-lubricating, positive, axial-flow unit employing a screw (rotor) which engages with a rotating plate to produce a positive, pulseless action. The rotor and plate wheel are the only moving parts, the rotor being rigidly supported on a shaft on taper roller bearings which, in order to retain the lubricant and to exclude foreign matter, are fully protected by lip seals. This rotor can turn in a clockwise or anti-clockwise direction, while mechanical face seals, running on ground and lapped faces, completely seal the shaft. A chamber between the seals and the bearings is fully vented to atmosphere and ensures that no fluid pressure can possibly build up against the bearing assembly. There is complete absence of metal-to-metal contact, all engaging surfaces being rubber-to-metal, fluid lubricated, which reduces frictional losses. A special relief valve is supplied where shut-down valves are incorporated on the delivery side.

The Goodyear pump can tackle air and liquid in any proportion, running continuously "on snore," while its simple positive action and low fluid velocity enable it to deal with thick and viscous fluids. It is expected to find ready acceptance in many industries, including mining and quarrying, contracting, chemicals, and petroleum. The type of drive is left to the choice of the user, for the pump is suitable for

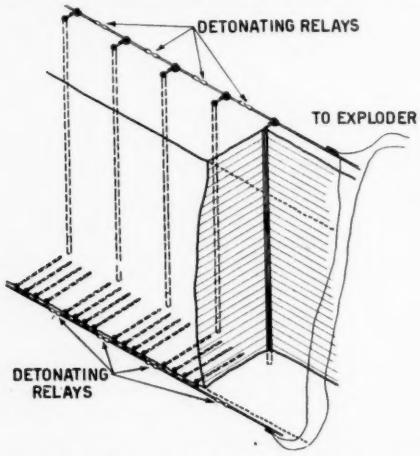


Goodyear Pump in Section : Showing rotor and wheel.

direct coupling, or vee-belt drive, by electric, petrol, diesel, or compressed-air motor.

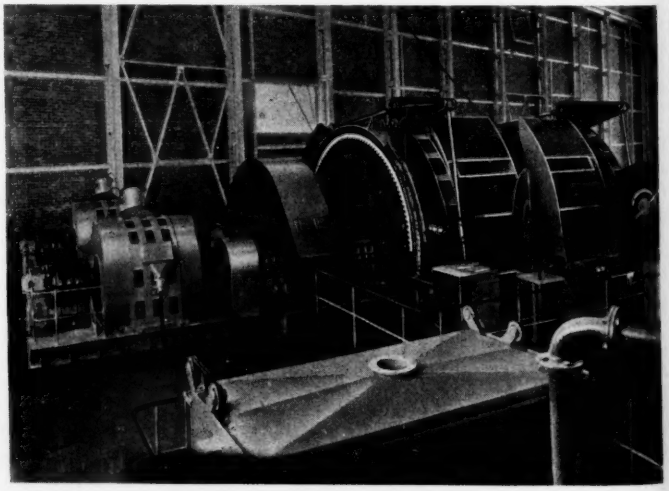
Detonating Relays

The use of detonating relays for short-delay blasting in open-cast mining is the subject of an illustrated booklet recently produced by the Nobel Division of **Imperial Chemical Industries, Ltd.,** of Imperial Chemical House, Millbank, London, S.W. 1. It is pointed out that by this method fragmentation is improved and excessive ground vibrations can be reduced. The diagram reproduced here illustrates the employment of this technique to blasts using vertical holes in combination with horizontal toe holes when it may be desirable to introduce a short delay between two sets of holes. Thus a detonating relay is introduced in the appropriate "Cordtex" line between the detonator and the first hole or group of holes. The booklet also contains illustrations showing both in diagram and photograph the method of attaching the relays to the fuse.



Shaft-Sinking Record

Particulars have been made available by the manufacturers of the winder equipment used for a new world record for shaft sinking established in South Africa at the No. 2 shaft of the Free State Saaiplaas Gold Mining Co., which is in the group of New Consolidated Gold Fields, Ltd. The 5,200-h.p. winder used in achieving this record was supplied by **Metropolitan-Vickers Electrical Co., Ltd.,** of Trafford Park, Manchester, and is one of four supplied by the company to the New Consolidated Gold Fields, Ltd. The winder is equipped with dynamic braking and is driven by twin a.c. motors operating from 6,600 V. supply. The mechanical equipment was manufactured by **Vickers-Armstrongs, (Engineers), Ltd.,** of Vickers House, Broadway, London, S.W. 1. The record was achieved during the first 30 days of regular sinking, when 22 Europeans and a local labour force of 240 worked throughout on a three-shift basis. In that time the shaft was sunk from 199 ft. to 1,033 ft. and lined with concrete for 810 ft. This sinking exceeds



Metropolitan-Vickers Winder at Saaiplaas

by 71 ft. the previous record of 763 ft. established at the Monarch shaft of the West Rand Consolidated Mines in September, 1955, it is stated. The Saaiplaas shaft has an excavated diameter of 29 ft. 6 in. and is concrete lined to a diameter of 27 ft. 6 in. It is believed that this is the largest diameter shaft in South Africa, if not in the world. The total weight of rock excavated during the 30 days was 51,900 tons. The illustration shows the winder which was used in achieving the new record.

Personal

R. J. D. ACHESON, of Mufulira Copper Mines, Ltd., has been awarded a Mond Nickel Fellowship to study the extraction and refining processes for copper and allied metals, with particular reference to economic aspects.

AARO E. AHO, geological engineer, has started his own consulting practice at 4219, Lions Avenue, North Vancouver, B.C. From 1953 to 1957 Dr. Aho was exploration manager for British Yukon Exploration Co., Ltd.

R. O'BRIEN has been appointed director and general manager of Head Wrightson Colliery Engineering, Ltd.

H. F. BROWN was here from Sierra Leone.

W. BROWN is home from Nigeria.

L. H. COOPER, chairman of the Mond Nickel Co., Ltd., has been elected a director of the International Nickel Co. of Canada, Ltd., of which he is vice-president.

L. H. CRUDEN is now in Ghana.

K. E. DANIEL is now in Canada.

A. G. DAVIES has been appointed a director of the Zinc Corporation, Ltd.

D. J. FARQUHARSON has been appointed a director of West Vlakfontein Gold Mining Co.

O. F. J. HUGHES is home from Burma.

ERIK JOHNSSON has been appointed sales director of the Atlas Copco Group in succession to J. A. Perham.

L. R. MABSON is returning from Uganda.

J. ALLAN PERHAM has been appointed resident director of the Atlas Copco companies in the United States.

D. M. G. SNEDDON has been appointed a director of the Imperial Smelting Corporation, Ltd.

W. J. D. STONE has left Gambia for Canada.

R. P. TAYLOR is leaving for Canada.

C. F. THWAITES is returning from Malaya.

E. J. WILLIAMS of John Summers and Sons, Ltd. has been awarded a Mond Nickel Fellowship to study the research and production techniques, quality control, and metallurgy of high-quality low-carbon strip steel in the United Kingdom, the Continent, and the United States.

N. W. WILSON is home from Sierra Leone.

T. H. WINSOR is returning from Burma.

H. MORTLOCK SCRUBY, who died in Clare, South Australia, on December 17, was actively engaged in Northern Nigeria before and during World War II, first as a mines manager and later as a consultant. He retired to Australia after the war.

ARTHUR ERNEST NORTHEY died on October 28, aged 82. Trained under his father on mines in Cardiganshire Mr. Northey later practised his profession abroad. He was working in Colombia from 1905 to 1909, from then until 1914 being active in Derbyshire. During the 1914–1918 war he was manager of tin-tungsten properties in Spain and then for a few years he worked with the late Mr. E. O. Forster Brown. Mr. Northey, who was a Member of the Institution of Mining Engineers and an Associate Member of the Institution of Mining and Metallurgy, was engaged largely in later years in civil engineering works in this country.

JOHN THOBURN WILLIAMSON, the owner of the Mwadui diamond mine in Tanganyika, died there on January 7, aged 50. Dr. Williamson graduated in geology and mineralogy from McGill University and then joined the Quebec Geological Survey, only to leave shortly afterwards for South Africa to work on the Rand as a geologist. His interest turned to diamonds and led him to Tanganyika, where for some five years he prospected in the Shinyanga district. In 1940 Dr. Williamson found the first diamond in the Mwadui area and further work in the following year enabled him to outline the kimberlite pipe on which the present property of Williamson Diamonds, Ltd., now stands. Dr. Williamson had of recent years suffered in health, but he had lived long enough to see the diamond industry in Tanganyika bear concrete witness to the faith he had long held.

STUART SIDNEY WEBB-BOWEN, who died on January 20, aged 73, graduated from the Royal School of Mines in 1904 and then became a post-graduate student in Western Australia until 1906. In the following two years he worked on other mines in Australia and was later engaged as assistant engineer on inspection work in Central America and the Far East. In 1912 Mr. Webb-Bowen went to Nigeria, where he remained until 1919, in which year he returned to this country to take a course in oil technology at the Royal School of Mines. For the next few years Mr. Webb-Bowen worked for oil interests in various parts of the world, but in 1927 he returned to mining and became active as a consultant. During the second World war he was for a time with the Ministry of Fuel and Power engaged in open-cast coal work. Mr. Webb-Bowen was a Member of the Institution of Mining and Metallurgy and an Associate Member of the Institute of Petroleum.

Metal Markets

During January [1]

Copper.—The copper market [2] has not made a very good start to 1958. Despite a good deal of talk about cutting production at various world centres and a certain amount of actual action in this direction the market generally has refused to shake off the pessimistic mood in which it ended 1957. Basically this attitude stems from the absence of any improvement in the level of consumption; in the U.S.A., indeed, consumption figures which come to hand still show a depressing tendency for offtake to slip back. With reports of the general level of

[1] Recent prices, pp. 72, 108.

[2] See Table, p. 108.

business activity across the Atlantic indicating poor prospects of an immediate upturn the corresponding stabilization and recovery in copper demand which is so seriously needed is equally far off.

With the actual achievements which have been made in the direction of reducing the level of output the market would probably be ready to take heart at any early indications of improved business in the U.S.A., but at the moment of writing virtually all the sensitive indices of business activity are still edging downwards. The question of a reduction in Chilean output has been one of the major talking points in January and it was finally announced that the big American mines there would be asked to cut back to 90% of 1956 output. Subsequently one of these mines has made efforts to preserve its Chilean operating rate at the expense of cuts in the U.S.A. Some indications have been made that the cuts that it intends to put against the proposed cuts in Chile are cuts that have in fact already been made in America ! In the same way one of the big Rhodesian groups which has hitherto made no production cuts of a voluntary nature has announced a 10% cut which a statistical analysis of the arrangements involved makes to look like rather less than 10%. Whether deliberate or not these manoeuvres have made the market highly sceptical of output reduction announcements.

When against the only bullish news there is in the form of reduced output at some mines is set a drop in the U.S. producers' price from 27 cents to 25 cents, it will be seen that the market has had good cause for its pessimism. Talk of an import duty in America of greater severity than the currently-inactive tariff is obviously not a bull point for the European market. Another new post-war free trading low price for copper has, as might be imagined, been established in January at £161 15s.,[1] and there are not many people even now who are prepared to declare that £150 per ton copper is impossible before the present depressionary phase has been purged from the market's system.

U.K. copper consumption in November amounted to 44,144 tons of refined and 11,464 tons of copper in copper and alloy scrap. Production was 8,577 tons primary refined and 8,103 tons secondary refined ; stocks of refined and blister metal fell to 68,444 tons and 13,213 tons respectively.

Tin.—The feature of the tin market in January has undoubtedly been the meeting of the International Tin Council, which was held in London in the closing days of the month. Right up to the time of the meeting the market had been more or less solidly down at the Buffer Stock support level with a backwardation that was at times substantial.[1] As with copper the metal was suffering from a fundamental lack of demand from the U.S.A. which even the heavy export cuts imposed in December had so far failed to counter. At the meeting it was announced that the quotas established in December had in fact been reduced further by making the closing date of the first period of restriction the end of March instead of March 15. At the same time quotas were established for the ensuing period ending June 30 at the same rate as the first period quotas, as amended. This effectively means that from December 15 to June 30 producing countries adhering to the Agreement may only export 60% of their performance in the year ending September 30, 1957. In addition the Council has called on Governments of producer countries to contribute to a Special Fund created to ensure that the Buffer Stock does not run short of funds before the effects of the export cuts take effect on the price mechanism and support becomes less necessary. An interesting point made at the meeting was that the Council estimated Russian tin exports to Europe in the year 1957 were 8,000 tons to 9,000 tons. It should be regarded as both sensible and encouraging that the provision for the Buffer Stock manager to start selling at £780 to prevent a runaway climb in prices has been extended to June 30 as well.

U.K. November consumption was 1,615 tons, over 300 tons off from the previous month. Production was higher at 3,918 tons and stocks rose to 10,591 tons.

Lead.—Lead has been a fairly featureless market in January and prices have exhibited a shade more stability than the other base metals.[1] The question of a possible (current opinion is probable) increase in the U.S. tariffs keeps the outlook fluid and confidence at a low ebb. European consumption has not increased from 1956, but as with other base metals the serious recession in consumption has been in the U.S.A. Mine output is quietly tapering off all the time but the statistical position still has no strength in it. A small contributory factor, however, was the marginal reduction in the quantity of lead which the U.K. Government is selling from its strategic stocks.

U.K. November lead consumption was 31,060 tons, the decrease being offset by a decline in production to 6,476 tons of new metal. Stocks were a little down at 48,065 tons.

Zinc.—The main feature of interest in zinc in January has been the announcement that Zinc Corporation and New Broken Hill Consolidated have stopped railing concentrates for overseas shipment ; this does not affect shipments to Tasmania. Coupled with the similar decision taken earlier by Mount Isa the move helped market sentiment somewhat, but the improvement has not been reflected by any great advance in prices,[1] as statistics coming in from the U.S.A. are still depressing in the extreme. Although the anticipated recommendation for higher U.S. tariffs may be made later than has been expected—say, early April—the market is still not prepared to retrace any of the downward steps which it has taken in discounting the bearish implications of this development in advance.

U.K. consumption of zinc in November was 26,705 tons, which means that the year's total looks like remaining within close distance of the 1956 figure. Production in November was 6,327 tons and stocks eased to 41,895 tons.

Iron and Steel.—The situation in the British steel industry is basically unchanged. Output of iron and steel continues at a high level but is below capacity, since home and overseas demand for a number of products continues to fall short of production capabilities. The " credit squeeze " is not confined to Britain and consumption of steel in most countries of the world is being restricted by various measures. Here light products—such as, bars and strip—are now in easy supply and some mills are not working to capacity. The recession in tinplate continues and this has spread to galvanized sheets and hot-rolled sheets (produced on the old-type mills and

[1] See Table, p. 108.

[1] See Table, p. 108.

of inferior quality to cold-reduced sheets) and the closure of works continues inexorably in South Wales. Heavy sections are still in fair demand and mills have good order books, but the future is not so bright. Plates are needed in bigger tonnages than home mills can at present supply, but, here too, easier conditions are developing, although it may be some time before imports can be dispensed with. With the motor-car industry continuing very active the call for cold-reduced sheet steel remains vigorous and requirements far exceed capacity, with the result that imports of 30,000 tons or more a month are being effected and this rate of arrival may well go on for some time. Indeed, sheets are likely to form the bulk of imports of finished steel into the U.K. for the first half of this year at least.

January export figures are not available yet but their publication is awaited eagerly. With home demand tapering off steelworks are concentrating on overseas markets, but they will be hard put to it to increase sales over last year's record in view of the current situation in most foreign countries.

Iron Ore.—In 1957 U.K. imports of iron ore rose to the record figure of 15,919,315 tons, against 14,330,104 tons in 1956. Sweden continued to be the biggest exporter—4,279,102 tons in 1957 against 4,358,010 tons in 1956—but Canadian deliveries increased to 3,040,417 tons from 2,495,290 tons.

Aluminium.—January was marked by a spate of cut-backs in the aluminium producing industry in many countries. The Aluminum Company of America has temporarily stopped construction work on three of the projects in its $100,000,000 expansion programme. The largest of the affected facilities is the $80-million reduction plant at Warrick, Indiana, which was originally to have been completed about the end of this year. The company has also closed down three of its 11 potlines at its Alcoa, Tennessee, plant, the oldest being operated by Alcoa. The reason given for these curtailments is the current lack of consumer demand for aluminium coupled with the large stocks of metal held by the company. In Canada the Aluminum Co. of Canada have made cuts affecting Arvida, Shawinigan Falls, and Kitimat. Some 1,000 workers at these plants have been dismissed and there are another 800 still to go. The cuts are said to be equal to 60,000 short tons a year and bring the level of activity at Alcan's facilities down to about 80%. Coupled with the reduction made by the U.S.A. and those of Germany (V.A.W. has reduced output at Lunen by 30%) and Austria (the Ranshofen plant has cut its winter production by more than is usual) it becomes obvious that the big Western producers are making a serious effort towards balancing supply and demand on a world-wide basis. However, whether or not their efforts will hold up world price levels remains to be seen.

Canadian aluminium ingots delivered in the U.K. are still quoted at £197 a ton.

Antimony.—With not very much consumer demand for antimony in January, coupled with adequate supplies including material coming forward from Bolivia, the market weakened and about the middle of the month ore prices were lowered ; 60% material is now quoted at 19s. 6d. to £1 0s. 6d. per unit of metal and 50%–55% material 18s. 6d. to 19s. 6d. per unit, both being a fall of 6d. from the previous level. English regulus continues to be quoted at £197 10s. a ton.

Arsenic.—Following the low tonnage of arsenic imported into the U.K. during November (37 tons) imports in December soared to 255 tons, an unusual occurrence in a month which is generally associated with relatively-quiet trading conditions. Imports for the whole of 1957 totalled 3,294 tons, as compared with 5,551 tons in 1956. During January market conditions remained unaltered from previous months and arsenic metal is still quoted at £40–£45 a ton.

Bismuth.—No changes were noted in the bismuth market in the opening month of the year and the price of metal is quoted at 16s. a lb. Imports during December fell to 89,999 lb. from the 143,067 lb. imported in the previous month ; 1957 imports totalled 951,373 lb.

Cobalt.—January was a quiet month for cobalt with nothing of interest to report. Imports in December were extremely low at 14,138 lb., as compared with 357,829 lb. in November. The price of metal in the U.K. remains at 16s. per lb.

Cadmium.—As was mentioned in a previous report the price of cadmium in the United Kingdom was reduced to 10s. per lb., delivered, on January 2 for sticks and bars with the premiums for other shapes unaltered Towards the end of the month the quotation for foreign material was altered and is now quoted in a range of 10s. to 11s. 3d. per lb., delivered (duty paid).

About the middle of the month the U.K. Government announced that it would dispose of 12½ tons of cadmium rods which were held in its strategic stocks ; this material is being disposed of by open tender.

Chromium.—Once again the chromium metal market has failed to provide any interesting news and the price has remained unaltered at 6s. 11d. to 7s. 4d. per lb.

Tantalum.—December imports of columbite-tantalite increased from the previous month by 8 tons to 20 tons, as compared with 51 tons in December, 1956. Imports of the ore during 1957 totalled 447 tons, against 768 tons in the whole of 1956.

Owing to the uncertain state of the market it is still not possible to quote a market price for this material, but for purposes of royalty the Nigerian Government quotes 180s. a unit.

Platinum.—January is usually considered a quiet time for the platinum market and the past month has certainly been no exception. In fact the past four weeks have been the quietest known for some considerable time. Platinum on the open market has fallen once again in price and is now quotable at £26 to £26 10s. nominal per troy oz. With the position as it is at present and bearing in mind previous market action in like circumstances, a further lowering of the U.K. and Empire price might be possible. In the U.S.A. metal is now quoted at $75 to $80 per troy oz.

Iridium.—Despite the overall weakness in platinum group metals there has been no alteration in the quotation for iridium. The market price is still £27–£30 per troy oz.

Osmium.—Like iridium osmium has shown no change in the past week and the price is still quoted at £22 to £25 nominal.

Palladium.—After a considerable period of not very confident steadiness the price of palladium has fallen from a range of £7 10s. to £8 per troy oz. to a single quotation of £7 10s. This move was

certainly not unexpected and reflects the increasing weakness of platinum-group metals in general. It would appear that adjustments in other metals in the group might not be too far off.

Tellurium.—January was another month of little interest in the tellurium market with nothing of any significance emerging. The price is still quoted at 15s. to 16s. per lb.

Tungsten.—As was surmised in the last report a little more consumer buying interest became apparent during January. Users having utilized the majority of their stocks were forced on to the market and the price firmed up a little. Basically, however, the position is not a strong one, mainly owing to an excess of material bearing on the market. This is coming in the main from Bolivia, although latest indications are that material from this source is not coming forward quite so readily as previously. At present 65% material c.i.f. Europe is quoted at 95s. to 100s. per unit.

Nickel.—As far as nickel is concerned the past four weeks have not been very active and very little of real interest has emerged. Early in the month the International Nickel Co. of Canada announced a 2½ cent per lb. increase in the price of metal to domestic consumers. This rise from 69 to 71½ cents became effective on January 1 and is a reflection of a compensation for recent changes in exchange rates. Business on the open market is still not very brisk and is quoted at £700 to £800 nominal per ton, while allocated material is still being quoted at £600.

Imports of nickel into the U.K. during 1957 totalled 177,326 cwt., as compared with a slightly lower figure of 160,283 cwt. in 1956.

Chrome Ore.—Little of interest characterized the chrome ore market during January and as was mentioned in the last report there is still a lack of consumer buying interest. Material is still being offered from Russian sources, a factor which is no help to the already suffering market. Towards the end of the month came the news that the U.K. Board of Trade were to release about 650 tons of low-carbon ferro-chrome from their strategic stocks, a move not designed to assist the already weakened market; 48% material is still quoted at £17 5s. a ton.

Molybdenum.—Although it was noted in the last report that there were indications of an easier supply position in molybdenum owing to Anaconda's new Chilean anticipated production from El Salvador and probable increased production from Climax, as yet there are no definite signs of any real improvement. The market may have to wait a few months before the benefits of the increased output are felt. Molybdenite is still quoted at 8s. 5d. per lb. of metal contained f.o.b. Climax, Colorado.

Manganese.—Although perhaps a curious parallel to draw the manganese market during January has in one respect been somewhat like platinum. While immediately after the Christmas holiday a busy market is not expected this particular period has been quieter than is normally the case. The market is currently quoted nominally at 107d. to 115d. per long ton unit of Mn, c.i.f. Europe. It is rumoured that there is a possibility of a barter between the U.S.A. and India, America supplying grain in exchange for metallurgical-grade manganese ore and ferro-manganese.

Tin, Copper, Lead, and Zinc Markets.

Tin, minimum, 99·75%; Copper, electro; Lead, minimum, 99·75%; and Zinc, minimum, 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Jan. 9	730 10	731 10	175 17½	179 2½	72 6¼	72 8¾	63 0	62 6¼
10	730 10	731 15	175 17½	178 17½	72 12½	72 17½	62 17½	62 10¼
13	730 10	729 15	177 5	180 2½	73 2½	73 7½	63 12½	62 16¼
14	730 10	726 5	173 7½	176 5	72 12½	72 17½	62 12½	62 6¼
15	730 10	723 5	173 12½	176 2½	71 17½	72 7½	61 17½	61 7½
16	730 10	713 10	172 12½	174 17½	70 17½	71 6¼	61 7½	60 17½
17	730 10	711 10	171 17½	174 17½	71 7½	71 12½	61 7½	61 2½
20	730 10	714 10	171 2½	173 12½	71 16¼	72 2½	61 7½	61 2½
21	730 10	710 10	169 5	172 2½	71 7½	71 12½	61 3¾	60 17½
22	730 10	712 5	167 12½	170 5	72 7½	73 2½	63 7½	62 18¾
23	730 10	713 15	165 12½	168 2½	72 7½	72 16¼	62 12½	62 2½
24	730 10	719 15	161 12½	163 15	71 12½	72 7½	62 12½	61 18¾
27	732 0	733 10	163 5	165 12½	71 16¾	72 7½	63 2½	62 12½
28	731 0	731 5	163 15	166 2½	71 17½	72 13¾	63 7½	62 12½
29	733 0	732 5	163 17½	165 17½	72 3¾	72 8¾	63 12½	62 17½
30	735 0	735 5	167 5	167 17½	74 0	74 2½	64 12½	63 17½
31	733 0	733 5	163 15	165 12½	73 3¾	73 8¾	63 17½	63 7½
Feb. 3	730 10	729 15	169 15	170 15	73 15	73 17½	64 12½	64 2½
4	730 10	728 15	164 15	166 2½	73 0	73 2½	63 17½	63 7½
5	730 10	729 10	167 7½	168 7½	73 12½	73 12½	65 5	64 2½
6	730 10	731 5	164 17½	166 2½	73 7½	73 7½	65 2½	64 2½
7	730 10	729 5	163 17½	165 7½	73 7½	73 8¾	65 7½	64 8¾
10	730 10	727 5	162 12½	164 2½	73 18¼	73 13¾	65 2½	64 7½

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	December		January	
	Treated Tons.	Yield Oz.*	Treated Tons.	Yield Oz.†
Blyvooruitzicht	95,000	57,160	101,000	56,380
Brakpan	131,000	18,942	125,000	18,147
Buffelsfontein‡	108,000	35,724	106,000	35,172
City Deep	139,000	27,201	148,000	28,048
Cons. Main Reef	130,000	21,240	137,000	21,905
Crown Mines	222,000	34,012	231,000	35,604
Daggafontein	220,000	46,861	217,000	46,000
Doornfontein‡	84,000	35,280	86,000	35,733
D'rb'n Roodeport Deep	179,000	32,087	185,000	33,136
East Champ D'Or‡	11,500	393	12,000	285
East Daggafontein	91,000	15,167	90,000	15,000
East Geduld	120,000	36,902	127,000	39,053
East Rand P.M.	214,000	54,985	225,000	57,021
Eastern Transvaal Consol	18,700	6,044	18,000	6,064
Ellaton‡	32,000	7,357	32,000	7,294
Freddies Consol.	49,000	16,907	45,000	15,684
Free State Geduld	62,500	44,374	63,500	46,308
Geduld	83,000	13,174	86,000	13,620
Government G.M. Areas‡	60,000	10,266	65,000	11,392
Grootvlei Proprietary	195,000	41,603	195,000	41,544
Harmony Gold Mining	72,000	29,531	76,000	31,161
Hartebeestfontein‡	86,000	47,300	84,000	46,200
Libanon	103,000	23,034	103,000	23,083
Loraine	62,000	12,058	63,000	12,030
Luipaards Vlei‡	120,000	14,213	120,000	14,176
Marievale Consolidated	69,000	18,213	73,000	19,166
Merriespruit‡	—	—	—	—
Modderfontein East	131,000	13,166	138,000	13,936
New Kleinfontein	90,000	11,377	94,000	11,540
New Klerksdorp‡	10,400	1,124	9,400	868
President Brand	68,000	51,504	72,500	54,208
President Steyn	91,000	34,745	93,000	35,594
Rand Leases	168,000	25,284	160,000	24,280
Randfontein‡	159,000	13,998	179,000	15,755
Rietfontein Consolid't'd.	24,000	5,678	23,000	5,354
Robinson Deep	74,000	14,695	73,000	15,640
Rose Deep	56,000	7,297	56,000	7,760
St. Helena Gold Mines	112,000	32,920	118,000	34,693
Simmer and Jack	93,500	17,702	92,000	17,346
S. African Land and Ex.	86,000	17,451	86,000	17,750
S. Roodepoort M.R.	28,000	6,838	31,000	7,234
Spaarwater Gold	19,700	3,278	19,300	3,280
Springs	127,000	14,232	126,000	14,180
Stilfontein Gold Mining‡	107,000	52,627	108,000	53,622
Sub Nigel	66,500	16,958	66,500	16,609
Transvaal G.M. Estates	—	—	—	—
Vaal Reefs‡	67,500	30,648	67,500	30,365
Van Dyk Consolidated	71,000	13,200	77,000	13,592
Venterspost Gold	120,000	29,208	115,000	28,406
Village Main Reef	31,000	4,532	32,000	5,307
Virginia O.F.S.‡	97,000	24,736	98,000	25,970
Vlakfontein	48,000	17,281	48,000	17,067
Vogelstruisbult‡	98,000	22,639	96,000	21,914
Welkom Gold Mining	79,000	23,921	80,000	23,965
West Driefontein‡	75,000	72,185	75,000	72,370
West Rand Consol. ‡	200,000	19,141	183,000	16,500
Western Holdings	95,000	49,404	94,000	49,650
Western Reefs	114,000	26,453	104,000	25,344
Witwatersrand Nigel	17,600	4,264	17,800	4,304

† 248s. 4d. * 248s. 9d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
Sept.,* 1956	17,390,400	57 8	42 10	14 10	19,104,984
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	16,444,200	59 8	44 5	15 3	19,449,432
Jan., 1957	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	16,430,800	60 8	44 8	16 0	20,657,462
April	—	—	—	—	—
May	—	—	—	—	—
June*	16,785,200	62 4	45 1	17 3	22,595,371
July	—	—	—	—	—
August	—	—	—	—	—
Sept.*	16,699,900	64 0	45 6	17 3	24,193,575

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
January, 1957	1,279,071	39,221	1,380,351
February	1,341,130	29,912	1,318,052
March	1,288,140	38,765	1,405,422
April	1,366,657	36,979	1,398,667
May	1,361,688	45,361	1,450,668
June	1,405,307	24,957	1,420,021
July	1,395,064	53,099	1,479,439
August	1,426,340	38,941	1,459,794
September	1,400,745	37,611	1,438,356
October	1,416,211	39,996	1,456,207
November	1,386,047	36,470	1,422,517
December	1,366,354	35,789	1,402,143

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
April 30, 1957	343,240	30,154	372,996
May 31	341,199	29,906	373,394
June 30	335,756	29,411	371,105
July 31	329,142	29,083	365,167
August 31	322,847	28,604	351,451
September 30	315,955	28,170	344,125
October 31	310,428	28,020	338,448
November 30	305,104	27,619	332,723
December 31	299,137	27,623	326,760

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To Dec. 31		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	30,100	4,770	6,419
Electrolytic Zinc	12,504	656	3,390
Lake George	—	—	—
Mount Isa Mines**	59,268	3,820†	2,621
New Broken Hill	—	—	—
North Broken Hill	38,814	6,936	8,062
Zinc Corp.	84,748	14,624	16,181
Rhodesia Broken Hill*	—	4,000†	7,550†

* 3 Mths. ** Copper 1,970 tons. † Metal.

RHODESIAN GOLD OUTPUTS

	December		January	
	Tons	Oz.	Tons	Oz.
Cam and Motor	31,044	9,525	32,640	10,031
Falcon Mines	19,230	3,402	19,425	3,804
Globe and Phœnix	5,500	5,209	6,000	3,605
Motapa Gold Mining	13,900	1,737	—	—
Mazoe	2,991	898	3,141	930
Coronation Syndicate	11,340	4,033	11,400	4,409

WEST AFRICAN GOLD OUTPUTS

	December		January	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	61,201	13,926	60,153	14,986
Ariston Gold Mines	42,000	12,904	41,160	12,636
Ashanti Goldfields	28,000	22,500	30,000	22,500
Bibiani	33,500	6,900	33,500	6,900
Bremang	—	4,711	—	4,756
Ghana Main Reef	10,971	4,008	11,724	4,117
Konongo	5,130	3,925	5,520	3,855
Lyndhurst	—	—	—	—
Marlu	—	—	—	—
Nanwa	—	—	—	—
Taquah and Abosso	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1956		1957	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,619	5,841	44,337	6,134
February	41,858	5,347	41,607	5,697
March	43,799	5,543	43,831	8,179
April	46,577	6,346	46,754	6,854
May	45,822	7,891	42,650	5,606
June	45,996	6,838	46,682	6,441
July	46,178	7,084	41,922	5,781
August	46,427	6,531	44,001	5,897
September	44,654	6,400	45,762	5,677
October	44,486	6,473	46,838	5,570
November	42,648	6,599	—	—
December	43,327	6,008	—	—

WESTRALIAN GOLD PRODUCTION

	1955	1956	1957
	Oz.	Oz.	Oz.
January	65,711	66,388	106,722
February	63,441	94,638	64,949
March	111,675	66,944	67,121
April	62,211	60,415	66,435
May	61,672	62,294	64,886
June	64,201	63,570	65,142
July	63,441	69,883	74,420
August	70,221	72,303	75,727
September	75,065	62,204	64,422
October	71,102	64,594	64,524
November	66,622	64,113	—
December	66,679	65,031	—
Total	842,004	812,377	—

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To Dec. 24		To Jan. 21	
	Tons	Oz.	Tons	Oz.
Boulder Perseverance	—	—	—	—
Central Norseman	14,093	7,818	14,022	8,215
Croesus Proprietary	—	—	—	—
Gold Mines of Kalgoorlie	41,595	11,452	39,978	11,357
Golden Horse Shoe*	—	—	—	—
Gt. Boulder Prop.*	—	—	—	—
Gt. Western Consolidated	39,408	6,717	39,706	5,930
Kalgoorlie Enterprise	—	—	—	—
Kalgurli Ore Treatment	—	—	—	—
Lake View and Star*	173,809	39,998	—	—
Moonlight Wiluna*	—	—	—	—
Morning Star (G.M.A.)	1,800	720	1,535	574
Mount Ida	—	—	—	—
New Coolgardie	—	—	—	—
North Kalgurli	26,272	6,385	26,551	5,929
Sons of Gwalia	14,318	2,564	—	—
South Kalgurli	—	—	—	—
Mount Morgan	—	4,171	—	3,634

* 3 Months.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
July, 1956	711,076	191,009	31,212	6,586,430
Aug.	676,402	182,147	30,140	6,290,128
September	701,236	192,979	26,355	6,627,079
October	754,191	212,490	34,854	7,159,732
November	747,059	209,797	34,135	7,102,110
December	741,525	213,846	60,129	7,180,865
Jan., 1957	759,681	210,404	33,082	7,114,391
February	702,636	197,225	32,199	6,635,527
March	793,674	215,830	35,787	7,250,018
April	771,608	216,457	35,685	7,314,450
May	790,159	222,436	37,241	7,509,638
June	738,384	207,897	32,544	6,945,127
July	718,468	198,620	30,620	6,572,323
August	701.174	192,453	31,647	6,410,429
September	722,384	205,471	34,248	6,947,813
October	772,383	224,217	37,086	7,657,426

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	Dec.		Jan.	
	Tons	Oz.	Tons	Oz.
British Guiana Cons.	—	860	—	—
Central Victoria Dredging	—	—	—	—
Clutha River	—	571	—	582
Emperor Mines (Fiji)*	—	—	—	—
Frontino Gold (Colombia)	—	—	—	—
Geita Gold (Tanganyika)	25,000	3,421	25,000	3,929
Harrietville (Aust.)	—	—	—	—
Lampa (Peru)†	—	39,560	—	36,064
Loloma (Fiji)*	—	—	—	—
New Guinea Goldfields	3,576	1,032	—	—
St. John d'el Rey (Brazil)	21,600	£108,000	—	—
Yukon Consol.	—	$30,000	—	—

* 3 Months. † Ozs. Silver: 64½ tons copper; 66¼ tons.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	Nov.	Dec.	Jan.
Ampat Tin	92½	90	—
Austral Amalgamated	165	—	—
Ayer Hitam	55	112½*	—
Batu Selangor	—	—	—
Berjuntai	144	117	—
Chenderiang	15½	47*	—
Gopeng Consolidated	—	243*	—
Hongkong Tin	47	128*	—
Idris Hydraulic	13	44½*	—
Ipoh	36	22	—
Jelapang Tin	—	—	—
Kampong Lanjut	102	91½	—
Kamunting	134	117½	—
Kent (F.M.S.)	—	55*	—
Kepong	33	155*	—
Killinghall	70	170½*	—
Kinta Kellas	45	36	—
Kinta Tin Mines	63	57	—
Klang River	—	—	—
Kramat	50½	47	—
Kuala Kampar	75	150	—
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	24½	24½	—
Lower Perak	155½	165	—
Malayan	212	619*	—
Malaysiam	10	23½	9
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	200	184	135
Pengkalen	—	116*	—
Petaling Tin	—	217*	—
Puket	48	182*	—
Rahman Hydraulic	26½	—	—
Rambutan	—	58	—
Rantau	67	59	—
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	60	76	—
Selayang	—	51*	—
Siamese Tin Syndicate (Malaya)	23	36	—
Southern Kinta	305	335	—
Southern Malayan	321	113*	—
Southern Tronoh	43	102*	—
Sungei Besi	150	369*	—
Sungei Kinta	17	20½	—
Sungei Way	124½	423*	—
Taiping Consolidated	72	58½	—
Tambah	—	—	—
Tanjong	58½	59	—
Tekka	—	49	—
Tekka-Taiping	30	34	30
Temoh	—	14*	—
Tongkah Compound	—	—	—
Tongkah Harbour	78	61½	—
Tronoh	227½	677*	—
Ulu Klang	—	—	—

* 3 Months.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	Dec.		Jan.	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines ..	310	29	—	—
Anglo-Burma Tin	19	—	21	—
Bangrin	60	—	—	—
Beralt	39	149†	38	130†
Bisichi	79½	10½	83½	19
Ex-Lands Nigeria	48	—	37	—
Geevor	55	—	63	—
Gold and Base Metal	52	7	—	—
Jantar Nigeria	23	15	21½	12
Jos Tin	12½	—	—	—
Kaduna Prospectors	7	—	5½	—
Kaduna Syndicate	38	—	19	—
Katu Tin	67	—	—	—
Keffi Tin	12	10	—	—
London Nigerian Mines ...	17	—	—	—
Naraguta Extended	17	—	—	—
Naraguta Karama	10½	—	—	—
Naraguta Tin	—	—	—	—
Renong Consolidated	40½	—	—	—
Ribon Valley (Nigeria) ...	24	—	—	—
Siamese Tin Syndicate	82½	—	—	—
South Bukeru	—	—	—	—
South Crofty	50½	—	—	—
Thabawleik	—	—	—	—
Tin and Ass. Minerals	—	—	—	—
Tin Fields of Nigeria	6	—	—	—
United Tin Areas of Nigeria	4½	½	—	—

† Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

November, 1957

Gold	1,421,121 oz.
Silver	153,422 oz.
Diamonds	381,242 carats.*
Coal	3,216,814 tons.
Copper	(*a*) 145 tons in matte and copper-gold concentrates. (*b*) 5,138 tons of 99·92%.
Tin	149 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	13,463 tons.
Chrome Ore	64,039 tons.
Manganese Ore	44,510 tons.
Lead Concs.	16 tons.

*Oct., 1957.

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		Nov.	Dec.
Iron Ore	tons	1,392,406	1,142,988
Manganese Ore	"	52,672	37,057
Iron and Steel	"	102,283	82,756
Iron Pyrites	"	32,928	35,384
Copper Metal	"	31,977	44,617
Tin Ore	"	8,302	5,821
Tin Metal	"	4,082	3,125
Lead	"	11,778	15,600
Zinc Ore and Conc.	"	23,161	28,866
Zinc	"	10,596	11,983
Tungsten Ores	"	535	504
Chrome Ore	"	15,386	12,750
Bauxite	"	26,140	35,424
Antimony Ore and Concs.	"	1,182	387
Titanium Ore	"	32,149	22,251
Nickel Ore	"	3,900	2,771
Tantalite/Columbite	"	12	20
Sulphur	"	24,751	18,746
Barytes	"	3,430	3,444
Asbestos	"	15,308	9,548
Magnesite	"	5,368	3,420
Mica	"	449	589
Graphite	"	686	384
Mineral Phosphates	"	64,608	81,237
Molybdenum Ore	"	622	763
Nickel	cwt.	27,676	20,528
Aluminium	"	515,798	429,931
Mercury	lb.	71,519	57,001
Bismuth	"	143,067	89,999
Cadmium	"	204,218	130,988
Cobalt and Cobalt Alloys	"	357,829	14,138
Selenium	"	4,459	16,552
Petroleum Motor Spirit ...	1,000 gals.	58,957	56,024
" Crude	"	651,407	617,713

Prices of Chemicals

The figures given below represent the latest available.

		£ s. d.
Acetic Acid, Glacial	per ton	106 0 0
" " 80% Technical	"	97 0 0
Alum, Comml.	"	25 0 0
Aluminium Sulphate	"	16 10 0
Ammonia, Anhydrous	per lb.	2 0
Ammonium Carbonate	per ton	59 0 0
" Chloride, 98%	"	26 0 0
" Phosphate (Mono- and Di-) ...	"	102 0 0
Antimony Sulphide, golden	per lb.	3 0
Arsenic, White, 99/100%	per ton	47 10 0
Barium Carbonate (native), 94%	"	Nominal
" Chloride	"	53 0 0
Barytes (Bleached)	"	20 0 0
Benzole	per gal.	5 2
Bleaching Powder, 36% Cl.	per ton	30 7 6
Borax	"	44 0 0
Boric Acid, Comml.	"	73 10 0
Calcium Carbide	"	40 17 9
" Chloride, solid, 70/75%	"	12 10 0
Carbolic Acid, crude 60's	per gal.	8 3
Carbon Bisulphide	per ton	62 10 0
Chromic Acid (ton lots)	per lb.	2 2½
Citric Acid	per cwt.	10 15 0
Copper Sulphate	per ton	67 0 0
Creosote Oil (f.o.r. in Bulk)	per gal.	1 1
Cresylic Acid, 97–98%	"	6 6
Hydrochloric Acid 28° Tw.	per carboy	13 0
Hydrofluoric Acid, 59/60%	per lb.	1 1
Iron Sulphate	per ton	3 17 6
Lead, Acetate, white	"	124 0 0
" Nitrate	"	116 0 0
" Oxide, Litharge	"	110 10 0
" Red	"	106 15 0
" White	"	104 15 0
Lime, Acetate, brown	"	40 0 0
Magnesite, Calcined	"	20 0 0
" Raw	"	9 0 0
Magnesium Chloride, ex W'h'se	"	16 0 0
" Sulphate, Comml.	"	15 10 0
Methylated Spirit, Industrial, 66 O.P.	per gal.	6 3
Nitric Acid, 80° Tw.	per ton	37 10 0
Oxalic Acid	"	129 0 0
Phosphoric Acid (S.G. 1·750)	per lb.	1 4
Pine Oil	per ton	Nominal
Potassium Bichromate	per lb.	1 2½
" Carbonate (hydrated)	per ton	74 10 0
" Chloride, 96%	"	21 0 0
" Iodide	per lb.	9 0
" Amyl Xanthate	"	Nominal
" Ethyl Xanthate	"	Nominal
" Hydrate (Caustic) solid	per ton	118 0 0
" Nitrate	per cwt.	4 1 0
" Permanganate	per ton	193 10 0
" Sulphate, 48%	"	22 6 0
Sodium Acetate	"	99 0 0
" Arsenate, 58–60%	"	Nominal
" Bicarbonate	"	15 0 0
" Bichromate	per lb.	1 0
" Carbonate (crystals)	per ton	Nominal
" " (Soda Ash) 58%	"	13 10 0
" Chlorate	"	90 0 0
" Cyanide 100%, NcAN basis	per cwt.	6 6 6
" Hydrate, 76/77%, solid	per ton	33 0 0
" Hyposulphite, Comml.	"	32 15 0
" Nitrate, Comml.	"	29 10 0
" Phosphate (Dibasic)	"	40 10 0
" Prussiate	per lb.	1 0½
" Silicate	per ton	11 0 0
" Sulphate (Glauber's Salt)	"	9 15 0
" " (Salt-Cake)	"	8 0 0
" Sulphide, flakes, 60/62%	"	37 2 6
" Sulphite, Comml.	"	27 10 0
Sulphur, American, Rock (Truckload)	"	17 0 0
" Ground, Crude	"	19 0 0
Sulphuric Acid, 168° Tw.	"	10 15 0
" " free from Arsenic, 140° Tw.	"	8 3 0
Superphosphate of Lime, 18% P_2O_5	"	14 16 0
Tin Oxide	"	Nominal
Titanium Oxide, Rutile	"	177 0 0
" White, 25%	"	83 10 0
Zinc Chloride	"	Nominal
" Dust, 95/97% (4-ton lots)	"	104 0 0
" Oxide	"	88 0 0
" Sulphate	"	32 0 0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	Jan. 6, 1958 £ s. d.	Feb. 10, 1958 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	2 0 9	1 16 9
Blyvooruitzicht (2s. 6d.)	19 3	19 3
Brakpan (5s.)	4 3	4 0
Buffelsfontein (10s.)	1 19 9	1 15 6
City Deep	12 9	11 3
Consolidated Main Reef	12 3	10 9
Crown Mines (10s.)	1 2 6	1 0 0
Daggafontein (5s.)	1 5 0	1 5 3
Dominion Reefs (Ord. 5s.)	13 6	12 6
Doornfontein (10s.)	1 2 6	1 1 3
Durban Roodepoort Deep (10s.)	1 5 3	1 4 9
East Champ d'Or (2s. 6d.)	2 3	2 3
East Daggafontein (10s.)	7 9	7 3
East Geduld (4s.)	1 0 0	1 0 6
East Rand Proprietary (10s.)	1 19 0	1 16 9
Freddies Consol	3 9	3 0
Free State Dev. (5s.)	5 0	4 0
Free State Geduld (5s.)	4 2 0	3 17 6
Free State Saaiplaas (10s.)	16 6	12 3
Geduld	2 16 0	2 14 3
Government Gold Mining Areas (5s.)	3 6	3 3
Grootvlei (5s.)	15 0	13 3
Harmony (5s.)	1 12 9	1 10 0
Hartebeestfontein (10s.)	2 19 6	2 16 6
Libanon (10s.)	6 6	6 3
Loraine (10s.)	3 3	2 0
Luipaards Vlei (2s.)	9 9	10 0
Marievale (10s.)	17 3	16 6
Merriespruit (5s.)	3 9	4 0
Modderfontein B (3d.)	2 3	2 3
Modderfontein East	11 6	10 9
New Kleinfontein	3 9	3 3
New Pioneer (5s.)	1 7 3	1 5 6
New State Areas (10s.)	1 3	1 3
President Brand (5s.)	2 10 3	2 7 6
President Steyn (5s.)	1 8 0	1 7 3
Rand Leases (10s.)	3 9	3 6
Randfontein	1 4 0	1 5 6
Riebeeck (10s.)	12 9	11 6
Rietfontein (5s.)	8 0	7 9
Robinson Deep (7s. 6d.)	6 9	6 3
Rose Deep (9s. 6d.)	9 6	9 6
St. Helena (10s.)	1 17 3	1 16 9
Simmer and Jack (2s. 6d.)	3 9	3 9
South African Land (3s. 6d.)	18 9	18 6
Springs (5s.)	1 9	1 6
Stilfontein (5s.)	1 16 9	1 15 3
Sub Nigel (10s.)	12 3	11 3
Vaal Reefs (5s.)	2 0 0	1 16 6
Van Dyk (9s.)	3 6	3 3
Ventersdorp (10s.)	12 6	12 6
Virginia (5s.)	7 9	7 6
Vlakfontein (10s.)	14 6	14 3
Vogelstruisbult (10s.)	9 9	9 0
Welkom (5s.)	15 0	13 6
West Driefontein (10s.)	4 14 3	4 11 3
West Rand Consolidated (10s.)	1 5 0	1 1 6
West Witwatersrand Areas (2s. 6d.)	1 16 0	1 18 0
Western Holdings (5s.)	4 9 3	4 6 9
Western Reefs (5s.)	1 4 9	1 5 3
Winkelhaak (10s.)	17 3	15 6
Witwatersrand Nigel (2s. 6d.)	1 3	1 3
RHODESIA:		
Cam and Motor (2s. 6d.)	7 9	8 0
Chicago-Gaika (10s.)	13 9	13 9
Coronation (2s. 6d.)	3 9	3 6
Falcon (5s.)	7 0	7 0
Globe and Phœnix (5s.)	1 6 0	1 6 0
Motapa (5s.)	9	6
GOLD COAST:		
Amalgamated Banket (3s.)	10	1 0
Ariston Gold (2s. 6d.)	3 9	4 0
Ashanti Goldfields (4s.)	13 6	14 3
Bibiani (4s.)	2 3	2 3
Bremang Gold Dredging (5s)	1 3	1 5
Ghana Main Reef (5s.)	1 3	1 3
Konongo (2s.)	1 6	1 6
Kwahu (2s.)	2 3	2 0
Taquah and Abosso (3s.)	9	6
Western Selection (5s.)	4 9	4 3
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	2 0	2 0
Gold Mines of Kalgoorlie (10s.)	10 9	9 3
Great Boulder Propriet'y (2s.), W.A.	12 0	12 0
Lake View and Star (4s.), W.A.	1 0 0	1 0 6
London-Australian (2s.)	9	7
Mount Morgan (10s.), Q.	8 9	7 0
New Guinea Gold (4s. 3d.)	1 6	1 3
North Kalgurli (1912) (2s.), W.A.	7 0	7 0
Sons of Gwalia (10s.), W.A.	2 6	2 6
Western Mining (5s.), W.A.	8 9	8 3

	Jan. 6, 1958 £ s. d.	Feb. 10, 1958 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	2 1 6	2 10 0
Kentan Gold Areas (1s.), E. Africa	4	4
St. John d'el Rey, Brazil	2 6 3	2 11 3
Yukon Consolidated ($1)	4 0	4 3
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	15 9	11 3
Esperanza (2s. 6d.), Cyprus	1 3	1 3
Indian (2s.)	2 9	3 0
Magundi (5s.)	4 0	2 3
Messina (5s.), Transvaal	3 16 3	3 6 3
Mount Lyell, Tasmania	17 0	16 6
Nchanga Consolidated, N. Rhodesia	8 17 0	8 8 0
Rhokana Corporation, N. Rhodesia	25 0 0	21 0 0
Roan Antelope (5s.), N. Rhodesia	7 9	7 0
Tanganyika Concessions (10s.)	5 10 0	4 11 3
LEAD-ZINC:		
Broken Hill South (5s.), N.S.W.	3 0 0	3 2 6
Burma Mines (3s. 6d.)	2 0	2 0
Consol. Zinc Corp. Ord.	2 9 6	2 6 9
Electrolytic Zinc, Tasmania (Pref. 5s.)	2 12 6	2 12 6
Lake George (5s.), N.S.W.	4 0	2 9
Mount Isa, Queensland (5s. Aust.)	1 2 6	1 2 3
New Broken Hill (5s.), N.S.W.	1 14 9	1 12 6
North Broken Hill (5s.), N.S.W	3 18 9	3 17 6
Rhodesia Broken Hill (5s)	8 0	6 6
San Francisco (10s.), Mexico	19 9	19 6
TIN:		
Amalgamated Tin (5s.), Nigeria	5 9	5 6
Ampat (4s.), Malaya	7 6	7 0
Ayer Hitam (5s.), Malaya	1 4 6	1 1 0
Beralt (5s.), Portugal	1 5 9	1 9 3
Bisichi (2s. 6d.), Nigeria	3 6	3 3
Ex-Lands (2s.), Nigeria	2 0	1 9
Geevor (5s.), Cornwall	15 3	15 0
Gold Base Metals (2s. 6d.), Nigeria	1 0	9
Hongkong (5s.), Malaya	6 0	5 9
Jantar Nigeria (3s.)	2 6	2 0
Kaduna Syndicate (2s.), Nigeria	2 3	2 3
Kamunting (5s.), Malaya	8 3	8 3
Kramat Fulai (3d.), Malaya	3 9	3 6
Malayan Tin Dredging (5s.)	11 3	9 9
Mawchi Mines (4s.), Burma	2 6	2 0
Naraguta Karama (5s.), Nigeria	9	9
Pahang (5s.), Malaya	4 9	4 6
Siamese Synd. (5s.)	8 6	8 3
South Crofty (5s.), Cornwall	6 6	5 9
Southern Kinta (5s.), Malaya	15 9	16 3
Southern Malayan (5s.)	9 0	9 0
Southern Tronoh (5s.), Malaya	8 6	8 3
Sungei Besi (4s.), Malaya	13 0	11 6
Sungei Kinta, Malaya	16 0	16 0
Tronoh (5s.), Malaya	9 9	9 3
United Tin Areas (2s. 6d.), Nigeria	4½	4½
DIAMONDS:		
Anglo American Investment	7 13 0	7 6 3
Consol African Selection Trust (5s.)	11 0	11 9
Consolidated of S.W.A. Pref (10s.)	10 3	10 9
De Beers Deferred (5s.)	4 0 9	4 9 0
FINANCE, Etc.		
African & European (10s.)	3 0 0	2 13 9
Anglo American Corporation (10s.)	6 4 3	5 5 0
Anglo-French Exploration	1 2 9	1 1 6
Anglo Transvaal 'A' (5s.)	1 10 0	1 9 3
British South Africa (15s.)	2 11 3	2 8 9
British Tin Investment (10s.)	16 9	15 6
Broken Hill Proprietary	1 17 0	1 14 3
Camp Bird (10s.)	9 2	—
Central Mining	2 17 6	2 14 6
Central Provinces Manganese (10s.)	1 3 9	1 3 0
Consolidated Gold Fields	2 11 9	2 7 9
Consolidated Mines Selection (10s.)	1 14 3	1 12 0
East Rand Consolidated (5s.)	1 6	1 3
Free State Development (5s.)	5 0	4 0
General Exploration O.F.S. (2s. 6d.)	3 0	3 0
General Mining and Finance	3 16 3	3 13 0
H.E. Proprietary (5s.)	8 0	7 9
Johannesburg Consolidated	2 7 6	2 3 9
London & Rhod. M. & L. (5s.)	7 0	7 0
London Tin Corporation (4s.)	7 3	7 3
Lydenburg Est. (5s.)	13 0	10 9
Marsman Investments (10s.)	2 6	2 6
National Mining	1 0	9
Rand Mines (5s.)	3 11 0	3 5 9
Rand Selection (5s.)	1 14 3	1 11 6
Rhodesian Anglo American (10s.)	3 6 3	2 12 6
Rhodesian Corporation (5s.)	4 3	4 0
Rhodesian Selection Trust (5s.)	14 6	13 9
Rio Tinto (10s.)	2 12 0	2 9 0
Selection Trust (10s.)	3 7 0	3 2 0
South West Africa Co. (3s. 4d.)	16 3	16 3
Union Corporation (2s. 6d.)	2 0 6	1 16 9
West Rand Inv. Trust (10s.)	2 2 9	2 0 9
Zambesia Exploring	2 4 6	2 1 0

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Wood Contamination in Asbestos Mining

The issue of the *Precambrian* for December last contains a series of articles dealing with the asbestos industry in Canada. One of these, by R. Guimond, is entitled "Eliminating Wood in Asbestos Mining." The author says that wood has been one of the most widely-used commodities in all methods of mining operations whether open-pit or underground and until recently represented a major overhead expense in spite of the fact that many mines have their own timber limits from which to obtain a supply of ties, pit props, and construction timbers.

The asbestos industry is unique in that the presence of wood in asbestos ore is definitely undesirable and is, in fact, considered a contaminant to asbestos fibre. In splinter form it is extremely difficult to separate from the asbestos by dry milling method as it becomes covered with ore dust and almost indistinguishable from the asbestos itself. A small particle of wood is sufficient to damage the manufacturer's machinery, slow his process, and cause flaws in the finished products. Finally, the author says, as asbestos is mined principally for its heat-insulating and fireproof properties, the necessity of eliminating wood fibre can easily be seen.

Asbestos is guaranteed when shipped by the producer to have certain qualities from which the customer expects a pre-determined performance. The presence of wood in various manufactured asbestos products is the most frequent cause of rejection. Finished products—such as, asbestos paper, brake lining, gaskets, etc., containing as little wood as can be found in a toothpick or a match—may be the cause for the refusal of a complete shipment by the purchasing client.

During the infancy of the asbestos industry mining techniques demanded the use of wood and although the use of it caused a considerable number of headaches it could not be eliminated at that time. As coal mining had slate pickers, so the asbestos industry had wood pickers. Many men were required to pick this material by hand, with the inevitable result being that much of it was overlooked and ended up in the fibre. Eventually the industry came to the conclusion that the only logical way to keep wood out of the finished product was to remove it from the source and a timberless technique was evolved which after much trial and error proved to be quite satisfactory.

When serious consideration was first given to the elimination of wood the open-pit operation was the usual method of asbestos mining. On this type of operation the chief offender was the railroad tie, which became broken and splintered during operations. Steel ties capable of carrying an 85-lb. rail were not then available and had to be manufactured in the mine's own shop. The introduction of the steel rail marked the beginning of a new conception in mining methods. Some of the features to be noted in the timberless technique are listed :—

(1) Six-inch and 8-in. steel H-beams are now frequently used to timber drives and support mine workings. Steel plate and old rails are used for lagging and packing is usually done with broken rock. More recent practice is to use massive unreinforced concrete for all such purposes wherever possible, the concrete being placed behind steel or aluminium portable forms by pneumatic or mechanical placers. Rock bolts and wire mesh are used extensively wherever they are applicable.

(2) In new haulage drives arched sets are used and some yieldable arch sets are being installed.

(3) Steel ties are used for track.

(4) Ore chutes are all-steel construction.

(5) Metal survey plugs are used.

(6) Explosives are removed from wooden boxes on the surface and are transported into the mine in waterproof canvas sacks. A recent innovation is the supply of explosives in specially treated cardboard boxes.

(7) Such wooden planks and wedges as must be taken underground are covered with old belting or ruberized fabric.

(8) The workmen are not permitted the use of matches, but must use lighters.

Practically all major uses of wood have been eliminated but a few of the smaller ones still persist. In the indoctrination of new employees it is sometimes difficult for them to understand why the use of wood in any form is forbidden and they are often amazed when told that they can not carry wooden matches in their pockets.

Due to the fracturing nature of asbestos-bearing ore it is often necessary to do a 100% timbering job and it is quite common to use fore-poling and spilling to go through caving ground. In severe slicken-sided areas breast-boards are required to keep the face itself from caving. At the beginning steel timbers were installed which were incapable of taking the necessary load, as weak ground was often encountered which exerted vertical pressure as well as side pressure.

With no previous experience to go by studies were undertaken on underground mining practices in various parts of the continent. As certain mines became ready for underground development the experience of the older mines was used to advantage. Added improvements from the experience of the second mine was in turn made available for others. This accounts in part for the high degree of co-operation existing in the asbestos-mining fraternity.

The nature of the rock structure in the asbestos fields being what it is (from soft shear zones to hard granitic dykes) the ore generally is weak and deteriorates on exposure to air. As a result it was found feasible to adopt the block-caving system of

mining, where caving is induced by mining out horizontal slices above slusher or grizzly drive points and across the bottom of the block.

Another source of wood splinters which companies have not as yet been too successful in eliminating is that of shovel and sledge-hammer handles. Shovels made completely of aluminium are now being tested in a number of mines in an effort to control the problem. Steel shovel-handles have been tried but proved impractical due to a handle twist that developed.

Blasting-poles and even loading sticks for putting dynamite into holes were also wood sources that had to be eliminated. To-day flexible plastic rods and steel blasting-poles are used.

In other types of mining stairways and ladderways are made of wood; these same items in the asbestos industry are now made of steel. Platforms are made of sheet steel with angle-iron or pipe handrails.

It was, however, in the conversion from open-pit mining to underground mining that the most difficult problems fell upon the engineering staffs of the various mines in forestalling the wood hazard. It was in the Thetford Mines area of Quebec that the underground programme in asbestos mining was initiated on the properties of the Asbestos Corporation, Ltd., Bell Asbestos Mines, Ltd., and the Johnson's Co., Ltd., when the King mine of the Asbestos Corporation started caving-in operations in August, 1932. The Johnson's Co. began drawing ore from caving blocks in 1940, with Bell Asbestos following in December, 1951.

At Canadian John's-Manville at Asbestos this company started to sink their shaft in July, 1944, with production beginning in early 1949. In this programme the undercut drives are drilled with a series of sunburst holes. When the undercut is blasted the block starts to work down. The ore is then pulled through the grizzly rise into a slusher drive to the loading level below. Although the drives are cut into solid rock the pressure from caving is at times tremendous and the pressure on steel supports is of such force that it could not be withstood by wood.

Heavy steel supports reinforced by concrete were found to develop lines of weakness and the concrete was subject to cracking, either by the caving of the ore or by the vibration caused during blasting operations. Experimenting further with concrete an improvement in strength was obtained by eliminating the reinforcing steel. To-day, with the exception of draw-points, drives are now lined with pressure-poured concrete to a thickness of anywhere from 16 in. to 24 in.

Aluminium and magnesium forms made in the mines' shops are now used for concreting slusher or grizzly drives, haulage drives, and shafts. Aluminium and magnesium forms are ideal due to their strength and lightness. Pressure-packed concrete is poured behind the forms. After sufficient time has elapsed for curing the forms are dismantled and used again. A crew will handle 40% to 60% more work when using light-metal forms instead of the steel forms. These forms for concreting are now used in all the asbestos mines which draw the ore from underground and where concrete is standardized.

To-day, due to the precautions taken by asbestos producers, it is almost impossible for wood, or for that matter any impurity, to enter the finished product. In their battle to remove wood from mining procedures they have introduced a new concept of underground operations.

Uranium Provinces

Bulletin 1046-F of the United States Geological Survey by M. R. Klepper and D. G. Wyant is entitled " Notes on the Geology of Uranium " and contains a useful bibliography. A final section deals with the conception of " uranium provinces." The authors say that geological and geochemical evidence indicates that parts of the earth's crust are richer in one or more elements or exploitable concentrations of these elements than other parts. Parts of the North American continent, the Mississippi Valley area in particular, are richer in lead and zinc deposits than others; Arizona and parts of New Mexico and Nevada are unusually rich in copper deposits, and parts of Idaho and Arkansas are rich in niobium. Similarly certain areas are richer in uranium deposits than others. Some of the areas seemingly poor in uranium deposits are geologically similar to areas relatively rich in uranium deposits. Uranium provinces may reflect differences in composition of the primordial earth or they may have originated and been maintained solely by geochemical processes activated by cyclic tectonic forces. In any event the recognition of a province may lead to new discoveries of uranium ore.

A uranium province is defined in this Bulletin as a broad and generally indefinitely bounded area in which uranium deposits and uranium-rich rocks are relatively abundant. Commonly the deposits are of several types and of more than one age. Most of the important uranium deposits are clustered in a few such areas—notably, the broad belt in and adjacent to the Rocky Mountains, extending from New Mexico and Arizona to the Dakotas and Montana; the western and southern parts of the Canadian shield; the north-eastern part of the South African shield; parts of the Australian shield; the Erzgebirge and vicinity in central Europe, and the Fergana-Kara Tau region in Russian middle Asia. Outside of uranium provinces significant uranium deposits are sporadically distributed, sparse, or lacking.

In contrast there are broad areas in which uranium deposits, other than low-grade syngenetic concentrations in phosphorite, black shale, or pegmatites, are sparse or lacking. For example, in the eastern third of the United States in and adjacent to the Appalachian Mountains no important uranium deposits have been reported though there are low-grade syngenetic concentrations in black shale and scattered pegmatites and a few small epigenetic deposits of carnotite in sandstone. The main geological features of the seemingly uranium-poor Appalachian region are in many respects similar to those of the uranium-rich Erzgebirge region. Both these areas are strongly deformed geosynclinal belts intruded by granitic plutons and flanked and in part covered by erosional

debris from orogenic mountains. The Triassic basins and the plateaux underlain by Pennsylvanian non-marine rocks in the Appalachian region are comparable to the Triassic and younger basins and plains marginal to the Erzgebirge. Nevertheless, in the Appalachian region, known uranium concentrations are few, low-grade, and mostly of syngenetic origin (black shale and pegmatite), whereas in the Erzgebirge region veins have been an important source of uranium for many years and strongly uraniferous coal has recently been reported. Similarly the geological history and features of the Canadian shield, the South African shield, the Fennoscandian shield, and the Brazilian shield are roughly similar, but the first two contain important uranium deposits whereas virtually none are known in the second two.

These observations suggest that parts of the earth's original crust were richer in uranium than others. Differences in metal content of the original crust would be expected if the earth formed by accretion of planetesimals and other cosmic material and never was completely molten. Whether significant differences existed or not the interplay of geochemical and tectonic processes, which tend to be cyclic, redistributed the uranium in the earth's original crust and in part concentrated it in exploitable deposits, most of which are clustered within broad and poorly defined areas or provinces that have persisted for long periods of geological time. As deposits of one type are destroyed others in equilibrium with the existing environment are formed. The province persists so long as the geochemical processes that tend to concentrate uranium preponderate over the geochemical processes that tend to dissipate uranium.

At the present level of knowledge the only positive indicator of a uranium province seems to be the presence of a variety of types of abnormal concentrations, regardless of the amount of uranium concentrated in any particular deposit. However, the presence of a single epigenetic deposit in a geologically favourable area is sufficient to suggest that a uranium province may exist and if several deposits of a single type are known the chance is very good that other deposits will be found. All the concentrations in a province may be of about the same age, but because of the high degree of mobility of uranium deposits of more than one age are typical. The boundaries of uranium provinces are controlled by the interplay of many geological and climatic factors and consequently are likely to be rather indefinite. These criteria for the recognition of a province are perhaps obvious and undoubtedly incomplete. Almost certainly they will be sharpened as new discoveries are made and as the viewpoints of geologists change as a result of increased geological and geochemical knowledge.

Prospecting

The province concept is considered valuable in roughly appraising the potential of an area in which uranium deposits are known and in pointing out settings within a province in which exploitable concentrations might profitably be sought. If an area is known or suspected to be a province every possible setting in which uranium might be localized should be investigated. These include acidic and alkalic igneous rocks and mineralized structures in the vicinity of such rocks; placers or sites where placers might occur; sequences of continental sandstone and shale, particularly those that contain abundant carbonaceous material, mixed with tuffaceous material and petroleum residues, or those cut by small acidic or alkalic intrusives; lignite and coal, particularly if it is (or was) overlain by acidic volcanic rocks or is in a basin through which ground water drained from a granitic, arkosic, or acidic volcanic terrane; metamorphosed black shale, and conglomerate-bearing sequences deposited on a crystalline basement. More specifically, if abnormally radioactive igneous rocks and a few vein deposits have been discovered in a mountainous orogenic belt, placers and other vein deposits in favourable structural settings might be found, particularly in the vicinity of igneous rocks. In the less deformed erosional debris within and marginal to this belt, especially if the climate is arid, semi-arid, or dry continental, one should look for deposits of the sandstone type, uraniferous lignite or coal, uraniferous petroleum residues, and perhaps placer deposits. As an example, deposits of all these types might be expected to occur in the Triassic and younger basins within and adjacent to the Bohemian massif and particularly in those adjacent to the Erzgebirge in the northern half of the massif. Similarly if sandstone-type deposits are found in a basin one might profitably look for vein deposits in the adjacent mountains, provided that acidic igneous rocks and favourable structures are present.

The same principles apply to ancient shield areas where veins, uraniferous rocks, and placers are most likely to be in the strongly deformed, metamorphosed, and intruded portions and uraniferous conglomerate may occur in peripheral rocks that are less strongly deformed, metamorphosed, and intruded. Though uraniferous coal and petroleum residues are not to be expected small deposits of modern uraniferous peat might occur locally. In any prospecting programme the probable influence of climate, both at present and in the past, should be carefully considered.

As a corollary to the province concept the authors would not expect to find more than a sporadic exploitable deposit in relatively recent eugeosynclinal belts or basic volcanic chains such as the Coast Ranges of California and Oregon, much of the Caribbean area, Hawaii, the Philippine Islands, the Aleutian chain, and Kamchatka and the Kurile Islands. Similarly, broad areas covered by rather thick sequences of relatively recent undeformed basaltic flows are relatively unfavourable, even though they may be surrounded and underlain by favourable geological settings. However, where eugeosynclinal rocks and especially basic igneous rocks have been involved in later orogeny and intruded by acidic igneous rocks, they may assume a relatively high degree of favourability, for many vein deposits seem to favour basic igneous host rocks.

In conclusion several criteria are listed for selecting areas deserving a high priority in the search for uranium :—

Positive Criteria.

(1) The presence of epigenetic uranium deposits, particularly if those deposits are of more than one type or age.

(2) The presence of acidic and alkalic igneous rocks, particularly small highly differentiated plutons of granitic and syenitic type.

(3) The presence of mineralogically complex veins of base and precious metals.

(4) The association of lignite or coal with acidic tuffs.

Negative Criteria.

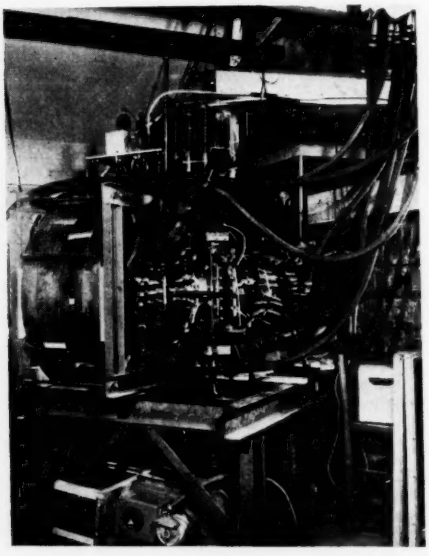
(1) The presence of abundant basalt, gabbro, and sedimentary rocks derived from such rocks and the lack of younger acidic igneous rocks.

(2) The rocks of the area are thin accumulations of essentially undeformed platform type that are not cut by acidic intrusives. Uraniferous black shale or phosphorite may be found in such environments but important epigenetic deposits probably will not.

(3) An extremely wet climate. Soluble uranium will tend to be flushed out of such areas.

Thermonuclear Research

As part of the recent announcement to the Press relating to progress in thermonuclear research Associated Electrical Industries, Ltd., have issued a brief description of work in this connexion carried out their research laboratory at Aldermaston, Berkshire. Initial work on this particular project was, it is stated, started under Sir George Thomson at the Imperial College and by an independent team under Dr. Thonemann at the Clarendon Laboratory, Oxford, this latter team reporting to the late Lord Cherwell. In 1950, as a result of the progress made by both groups, the Government decided that the importance of the work was such that it should be continued under security conditions. Secret work could not conveniently be continued in a university research department and consequently in 1951 the group at Oxford was moved to Harwell and the Imperial College group to Aldermaston. The two teams at Harwell and Associated Electrical Industries have been the main teams working on controlled thermonuclear research in this country, it is stated, and they have worked in close collaboration. Joint progress meetings have taken place every three months and, since the two laboratories are only 20 miles apart, it has been possible for the scientists to visit each other regularly.



Sceptre III

The type of approach followed by both groups has been the " pinched toroidal " gas discharge. The magnetic field associated with a high current in an ionized gas causes the particles to be pulled towards the centre of the discharge and away from the walls of the tube. This prevents the hot gas coming in contact with the walls and so helps to prevent them from being vapourized. By bending the discharge into a circle the problem of losses at the ends of a discharge tube is overcome. Such toroidal currents are produced by a changing magnetic field in an iron core threading the toroidal discharge tube. The magnetic field is produced by discharging a condenser through a primary winding wound close to the discharge tube, the principle being similar to that of a transformer.

The account goes on to say that early attempts made to produce the required temperatures failed because the pinched discharge was found to be highly unstable. It later became evident that the constricted discharge, instead of remaining straight and in the centre of the tube, develops kinks which grow in amplitude and touch the tube walls; this instability, called " wriggling," causes serious heat losses and vaporization of the tube walls. Finding out how to control these instabilities has been the main problem facing the investigators over the past four or five years. It has been found that a simple toroidal magnetic field parallel to the gas discharge combined with a metal discharge tube could produce stability under certain conditions. A discharge of this type was first achieved in the apparatus known as ZETA at the Atomic Energy Research Establishment. Following this success a similar discharge was produced and high temperatures obtained more economically at the Associated Electrical Industries Research Laboratory.

This was done in a smaller apparatus known as SCEPTRE III, which is an aluminium toroidal tube made of 12 in. diameter tubing, the mean torus diameter being 45 in., threaded by an iron core weighing 4 tons. Many experiments have been performed with this apparatus discharging into it energies up to 40,000 joules; currents up to 200,00 amps. have been generated and temperatures of nearly 4,000,000° have been measured. At temperatures of from 2·3 to 3·8 million degrees neutrons are emitted copiously over a time of several hundred microseconds, during which the discharge channel appears to be stable. Many experiments have been performed to establish the conditions under which the neutrons are emitted and the manner the number emitted varies with gas pressure, gas temperature, and with different values of the stabilizing magnetic field and the team is

pressing on with improving the efficiency of the use of electrical energy to achieve a plasma of even higher temperature.

The work, it is pointed out, has been supported for the most part by a contract from the Atomic Energy Authority, Associated Electrical Industries having invested the balance of the cost in the interests of science and in the firm belief that the difficult problem of the work will in due course be resolved. Sir George Thomson, now Master of Corpus Christi College, Cambridge, has maintained his interest continuously in this research, visiting the laboratory frequently and supplying theoretical ideas to the team.

The work is part of a great volume of nuclear physics which the company is now undertaking and has undertaken in smaller measure in Aldermaston since the inception of the laboratory in 1947. The Nuclear Physics Section under Mr. D. R. Chick has developed apparatus for accelerating atomic particles to very high velocities and has made important contributions to nuclear science in this field. More recently the company decided to design and construct a medium-powered nuclear reactor—a so called "swimming pool" reactor christened in Aldermaston "MERLIN"—for future research on many aspects of reactors and within half a year of being completed. The thermonuclear research is the third sub-division of the company's nuclear research at Aldermaston and Dr. Ware, who leads this, was Sir George Thomson's first research student on this work in Imperial College.

Platinum in Australia

Summary Report No. 39 dealing with the "Mineral Resources of Australia" and issued by the Commonwealth Bureau of Mineral Resources, Geology, and Geophysics covers "Platinum-Group Metals." The Report states that the only deposits of platinum-group metals of any significance in Australia are the secondary deposits at Adamsfield, Tasmania, and possible undeveloped deposits in Papua and New Guinea. The metals have been recorded in many places in most States but production has been confined to New South Wales, Victoria, Tasmania and Papua and New Guinea. There are no recorded occurrences of platinum-group metals in Western Australia or the Northern Territory.

Queensland.—Platinum and osmiridium have been detected in the beach-sand deposits along the southern part of the eastern coast of Queensland and in alluvial deposits in other parts of the State but the occurrences are of no commercial value.

New South Wales.—Fifield is 19 miles by road west of Trundle railway station, 315 miles west of Sydney. By far the largest production of platinum in Australia has come from this field. Platinum was first found there in 1887, but there was little activity on the field until the discovery of the Platina Lead in 1893 precipitated a rush to the district. In this area Silurian slates, sandstones, and limestones are intruded by dykes of a hornblende rock. In places the Silurian sediments are overlain by Devonian sandstones and conglomerates. A thick mantle of Pleistocene clay covers most of the country. The Platina Lead is an ancient watercourse containing a platinum- and gold-bearing wash. It extends for a little over a mile in a southerly direction and ranges from 60 ft. to over 150 ft. in width. The wash is overlain by 60 ft. to 70 ft. of reddish loam with some bands of barren quartz drift and dolomitic rock. The platinum and gold occur as coarse grains and are confined to depressions in the bedrock and the wash a few inches above. Nuggets of platinum up to 27 dwt. have been found. The wash dirt contained from 5 dwt. to 20 dwt. of platinum and from 1 dwt. to 3 dwt. of gold per ton. In the most southern workings, where the platinum-bearing wash was deepest, the metal was irregularly distributed in the wash and grades were lower than in the northern end of the lead.

In 1907 a lead was discovered on the surface two miles south-east of Fifield, near the Gillenbine Tank. The lead extended to the north for over a mile, where the platinum-bearing wash was overlain by 80 ft. to 90 ft. of barren material. The wash ranged from 40 ft. to 80 ft. in width and from a few inches to 3 ft. in thickness. In the northern working the lead is narrow and the metal contents lowest. The wash averaged 4 dwt. platinum and ½ dwt. gold per load.

Water-worn grains of gold and platinum have been found in a small outcrop of conglomerate and shales on "Jack's Lookout," a low hill two miles east of Fifield. The conglomerate is composed of rounded and sub-angular quartz pebbles in a ferruginous cement; it is evidently the remnant of an old lead possibly of Tertiary age. Boulders of this conglomerate have been found in the Platina and Gillenbine Tank leads. Platinum has been found on the surface near the conglomerate and it is probable that some, if not all, of the platinum in the leads was derived from the denudation of this conglomerate. Platinum-bearing lodes have not been found in the Fifield area and the original source of the metal has yet to be found. The field appears to be almost exhausted, the last recorded production being in 1945. The thick mantle of the Pleistocene clays makes prospecting for further deposits difficult. Fifield is in a region of low rainfall and operations in the past have been hampered by a scarcity of water.

The beach-sand deposits along the northern part of the eastern coast of New South Wales contain small quantities of platinum, gold, and cassiterite, associated with the zircon, rutile, and ilmenite. A narrow seam at Evans Head, "Macaulay's Lead," was mined for many years for its gold content; platinum was recovered as a by-product but the amount was very small. Thirty-one ounces of platinum are reported to have been recovered at Ballina between 1936 and 1938. Total production from these deposits appears to have been about 90 oz.

Small quantities of platinum occur associated with sills and lenses of serpentine in the Broken Hill district. The platinum is present in lenticular veins and gossanous material on the foot-wall side of the serpentine. The veins are discontinuous and range in width from a trace to 24 in. A picked sample of one vein was assayed and found to contain 1·1 oz. platinum, 0·8 oz. palladium, and 0·4 oz. osmiridium per ton. The deposits are regarded as being of no economic value.

A small quantity of platinum concentrate has in recent years been recovered by Wellington Alluvials, Ltd., as a by-product of gold-dredging operations on the Macquarie River near Wentworth.

Specimens of platinum have been recorded from many other localities in New South Wales.

Victoria.—Platinum and palladium occur in association with copper minerals at the Thomson River copper mine, about 3 miles south-west of Walhalla. The copper occurs as sulphide veins and disseminations in a hornblende dyke intruded into Silurian sediments. The ore contained 3% copper and 8 dwt. silver, 1 dwt. gold, and 5 dwt. of platinum and palladium per ton. The platinum occurs as sperrylite in very small grains and although palladium is more abundant than platinum palladium-bearing minerals have not been identified in the ore.

Small quantities of osmiridium occur in the beach sand at Waratah Bay in South Gippsland but no production has been recorded from this locality.

Tasmania.—Before 1925 the productive areas of Tasmania were confined almost exclusively to the western districts. They extended from Bald Hill over 30 miles in a south-easterly direction to South Dundas. This area contains several bodies of serpentine in a belt about 30 miles long and 1 to 5 miles wide. Other osmiridium deposits were known in the south-western parts of the State, but until the discovery at Adamsfield they were relatively unimportant. Primary deposits occur at a few localities where the ultra-basic differentiate consists wholly or partly of olivine and bronzite, whereas the monoclinic pyroxenites and gabbros are comparatively barren. Most of the mining has been carried out in the alluvial and detrital deposits derived from the primary deposits by denudation and concentration by surface waters. Approximately 97% of Australian osmiridium production has come from Tasmania.

Adamsfield is situated between the Gordon and Florentine Rivers 56 miles west of Hobart. It is reached by road from Maydena, the nearest railhead, 20 miles to the east. Since its discovery in 1925 this district has been the largest producer of osmiridium in Tasmania and in fact has produced more than 40% of the State's total recorded output. The oldest rocks in the district belong to the Dundas Group of the Cambrian. These are overlain by Ordovician sediments of the Junee Group, including the Owen conglomerates, quartzites, and Gordon limestones. These are succeeded by the Eldon Group (Silurian) sandstone beds. A large ultra-basic dyke, now consisting mainly of serpentine, has intruded the Ordovician beds. The plains consist largely of Pleistocene gravels; recent alluvium occurs along the present stream courses. Osmiridium from Adamsfield averages 45% osmium, 41% iridium, 6% ruthenium, 0·3% rhodium, and traces of palladium. The osmiridium occurs in both primary lodes and secondary deposits, but by far the greatest production has come from the secondary deposits. Small amounts of gold are recovered with the osmiridium.

The main lode occurs at the northern end of the serpentine dyke. It is a few chains from and parallel to the eastern wall of the dyke and has been traced for 15 chains. The osmiridium-bearing portion of the lode consists of possibly three narrow veins of foliated serpentine. Immediately to the west of the lode is a band of talc 10 ft. wide representing altered serpentine. At its northern end the lode occupies the contact between the serpentine and the Ordovician sediments. Lumps of chromite up to 4 in. in diameter occur in the lode and the serpentine and talc contain numerous small octahedral crystals of this mineral. The osmiridium is dark in colour owing to adhering serpentine and is found as nuggets up to 1 oz. or more in weight. The lode has been mined to a depth of 50 ft.; osmiridium was still present at that depth. Similar but smaller lodes probably occur in the district, accounting for the presence of osmiridium in localities not related to the main lode. Some of the osmiridium may have come from the serpentine itself. The greater proportion of the osmiridium has been shed from the eastern margin of the dyke, particularly from the vicinity of the lode at the head of Main Creek. Four major types of secondary deposits have been identified: surface soil deposits, detrital and residual deposits, alluvial deposits, and redistributed deposits.

By far the greatest production of osmiridium at Adamsfield has come from redistributed deposits; the osmiridium content of former detrital and alluvial deposits has been redistributed by present-day streams. The deposits consist of sands and clays with occasional pebbles which may be angular or rounded. The presence of angular pebbles indicates a detrital or eluvial origin, but the presence of the deposits along small stream valleys suggests an alluvial origin. The rounded pebbles are probably derived from older gravels.

The Bald Hill-Savage River field, 15 miles by road from Waratah, includes alluvial workings around Bald Hill itself and in the valleys of the Heazlewood River and Nineteen-Mile Creek. The source of at least part of the osmiridium is a small body of serpentine on Bald Hill and the deposits occur in eluvial material, Tertiary gravels, and Recent gravels along the stream courses. The stream gravels and river terrace of the Savage River have been worked over a distance of 15 miles.

The Mount Stewart deposits are in Recent stream gravels and are derived from a small area of serpentine in the headwater of Loughnan Creek. The field lies 13 miles south-west of Waratah.

The Wilson River field lies to the north of Renison Bell. The osmiridium, derived from serpentinized bronzite and peridotite, occurs in recent stream gravels and detritus lying on serpentines.

South Australia.—Platinum has been recorded at Mingary, near the New South Wales border on the Broken Hill railway.

Papua–New Guinea.—Osmiridium is found in Papua in alluvial deposits along the streams running off the serpentine belts of the Owen Stanley and subordinate ranges. The serpentine belts extend into the former Mandated Territory of New Guinea and osmiridium, usually associated with alluvial gold, has been found in several localities. Platinum-bearing alluvial deposits have been located in very isolated regions of the Central and Eastern Highlands but little development work has been done. Small quantities have been included in parcels of alluvial gold forwarded from the Waria and Ono Rivers and from the Sepik goldfield.

The total recorded production of osmiridium in Australia to the end of 1954 was 31,905·015 oz. of which Tasmania produced 30,929·603 oz. and Papua 971 oz. Osmiridium recovered in the platinum concentrates from Fifield, New South Wales, has not been recorded.

Geology of the Bancroft Area

Part 6 of the 65th Annual Report of the Ontario Department of Mines deals with "Radioactive Mineral Occurrences in the Bancroft Area," the author being J. Satterly. To this report D. F. Hewitt has contributed some notes on general geology. He points out that the host rocks of the radioactive deposits of the Haliburton–Bancroft area are all of Precambrian age. There are two main groups present in the area: The Grenville-type metasediments, mainly marble, paragneiss, and amphibolite and the plutonic rocks, mainly granite, syenite, and gabbro, together with their gneissic and hybrid equivalents. The oldest rocks are of the Grenville Series. These rocks were laid down as limestones, sandy and shaly limestones, and sandstones in early Precambrian seas. The sediments were intruded by a series of plutonic rocks, the oldest of which are gabbro, diorite, and ultrabasic rocks. These older basic intrusives were later metamorphosed and, in places, have been altered to metagabbro, metadiorite, amphibolite, or hornblende schist. After this period of basic intrusion three other groups of plutonic rocks were emplaced, the nepheline syenites, the syenites, and the granites. The nepheline syenites are the earliest of these. Cutting relations among the later granites and syenites of the Haliburton–Bancroft area indicate that more than one age of granite and syenite is present and several distinct lithologic facies of granite and syenite are recognized. During the emplacement of these rocks there was *lit par lit* injection, granitization, and syenitization, resulting in the formation of large areas of granitic and syenitic gneisses of hybrid origin. Dykes of granite and syenite pegmatite, and diabase, are the youngest Precambrian rocks in the area.

The Grenville metasediments are nearly all well banded, bedded, or foliated. They are classified lithologically into two major groups, the marble group and the paragneiss-amphibolite group. The calcareous and dolomitic marbles range in colour from pure white to grey or buff and may weather white, grey, blue-grey, or brown. Tremolite, diopside, scapolite, phlogopite, graphite, pyrite, spinel, vesuvianite, apatite, quartz, microcline, and plagioclase often occur as impurities in the marble. When lime silicate minerals occur as abundant accessories the rock is termed silicated marble. In the vicinity of intrusives, especially where marble occurs as relicts or pendants in granite or granitized gneiss, metasomatic alteration has converted the marble to lime-silicate rocks. Metamorphic pyroxenite is a special variety of lime-silicate rock composed of dark-green diopside or augite, often with some phlogopite mica. Bands of limestone or portions of limestone bands adjacent to intrusives are frequently altered in place to metamorphic pyroxenite. In the area several uraninite deposits of the metasomatic type occur in metamorphic pyroxenite. Skarn is a term used for an assemblage of lime-silicate minerals—usually pyroxene, scapolite, and phlogopite, often accompanied by calcite, apatite, garnet, pyrite, vesuvianite, and magnetite—which has been formed by the contact metamorphism or assimilation, digestion, and reconstitution of limy rocks. The term is used to describe patches and pods of lime-silicate minerals that frequently occur in pegmatites of the Centre Lake type.

The rocks of the paragneiss-amphibolite group can be divided into three main divisions: (1) Amphibolite and pyroxene granulite; (2) paragneiss; (3) quartzo-feldspathic and feldspathic gneiss and quartzite. With the amphibolites are grouped all the metamorphic gneisses that are essentially limy enough to contain hornblende, pyroxene, or scapolite *plus* plagioclase, but with insufficient free carbonates to be termed limestone. They are probably derived from limy shales. The most common variety of amphibolite is hornblende-plagioclase gneiss. Other common assemblages in the amphibolite group are hornblende-pyroxene-plagioclase gneiss; biotite-hornblende-plagioclase gneiss; biotite-hornblende-pyroxene-plagioclase gneiss; hornblende-scapolite (plagioclase) gneiss; biotite-scapolite gneiss, and garnet-hornblende-plagioclase gneiss. The most common pyroxene is light-green diopside.

The paragneisses include those rocks developed from shales and sandy shales and are characteristically biotite-quartz-feldspar gneisses. In this group are all the pelitic gneisses—garnet-biotite-quartz-feldspar gneiss, garnet-sillimanite-biotite-quartz-feldspar gneiss, and biotite-hornblende-quartz-feldspar gneiss, etc. Feldspathic and quartzo-feldspathic gneisses are those in which the mafic minerals are present in amounts of less than 30%. In some areas quartzite is present.

South and east of the Haliburton–Bancroft area, some metavolcanic rocks occur interbedded with the metasediments, but none are found in the area herein described.

Small bodies of gabbro, diorite, and metagabbro occur in intruding Grenville metasediments. Nepheline and associated alkaline syenite gneisses occur in a narrow band extending eastward from Glamorgan through Monmouth, Cardiff, Faraday, and Dungannon townships. These rocks are intruded by later granite and syenite gneisses and pegmatites.

Hybrid granite gneisses underlie a large part of the Haliburton–Bancroft area. The main bodies of granitic gneiss are, to the north, granite gneisses which extend across the whole area. The Dysart granite gneiss occupies the northern part of Dysart township and is separated from the Glamorgan granite gneisses, which occupy Snowdon and Glamorgan townships, by a narrow band of Grenville marble. The Glamorgan granite gneisses are separated from a series of four granitic batholiths to the east by a wide band of marble, paragneiss, amphibolite, nepheline syenite, and gabbro that narrows to the north towards Wilberforce. The most southerly of the four granite gneiss masses occupies Harvey and Burleigh townships and is called the Burleigh batholith. The Burleigh body is complex, consisting of a series of three north-trending synclines and anticlines in hybrid granite gneiss, pitching south. The second is the Anstruther batholith that has a double domical structure, with one dome centred in east-central Anstruther township and the other north-east of Catchacoma Lake. The Anstruther body is separated from the Burleigh body by the change in structure of the gneisses and by narrow discontinuous bands of Grenville marble and amphibolite. The Cheddar granite gneiss lies to the north of the Anstruther body, on the boundary between Monmouth and Cardiff townships. It is roughly circular in shape and is completely enveloped by conformable sheets of Grenville marble and amphibolite that wrap around it. The granite gneiss

within the Cheddar body is less foliated than the two to the south and may be an intrusive batholith. Structurally it consists of a major oval dome to the north and a small satellite dome to the south just north of Eels Lake. On the north side of the Cheddar body dips are steeply to the south. The Cardiff complex occupies the north-eastern part of Cardiff township and consists of granite gneiss, syenite, and metasediments, with metasediments being much more prominent than in the bodies to the south. There is a general overturned domical structure centred at Deer Lake. The main features of the Cardiff body are sheets of leucogranite gneiss on the south and east flanks of the dome, the most prominent of which are the Centre Lake and Monck Lake leucogranite gneisses and a large body of alkaline syenite, the Deer Lake syenite, lying in a south-dipping sheet just south of Deer Lake. To the east of this series of the four there is a wide belt of Grenville metasediments, chiefly marble, extending to the edges of the area here described.

Most of the radioactive deposits appear to be concentrated within the mixed gneiss belts near the contacts of the granitic gneisses or within the granite gneiss bodies near their margins. There is a concentration of deposits in Cardiff and Monmouth townships around the Cheddar and Cardiff bodies and in Faraday township, along the gneiss-metasediment contact zone, south of the Faraday granite sheet.

The radioactive mineral deposits of the Bancroft area may be subdivided as follows :—

(I) *Deposits in Granitic and Syenitic Bodies.*

(A) Simple bodies of intrusive origin (fissure-fillings) :—(1) unzoned (no known radioactive occurrences) and (2) zoned—granite pegmatite (MacDonald feldspar mine).

(B) Complex bodies of both intrusive and replacement origin *plus* assimilation of country rock. Typical ore-shoot units are :—

(1) Pyroxene granite (or syenite) pegmatite (Bicroft, in part) (Faraday, in part) (Halo, in part) (Greyhawk, in part) (Canadian Dyno, C zone).

(2) Leucogranite, leucogranite pegmatite ± magnetite (Faraday, in part) (Greyhawk, in part) (Canadian Dyno, B zone) (Cavendish) (Rare Earth).

(3) Cataclastic quartz-rich granite pegmatite (Bicroft, in part) (Greyhawk, in part) (Halo, in part).

(II) *Metasomatic Deposits in Limy Rocks.*

(A) Metasomatic deposits in marble and (B) metasomatic deposits in metamorphic pyroxenite.

(III) *Hydrothermal Deposits.*

(A) Calcite-fluorite-apatite veins (Fission) (Nu-Age) (Halo) ; (B) calcite-fluorite-apatite-biotite-pyroxene (Cardiff Uranium) and (C) calcite-biotite-apatite (Silver Crater, Basin property).

Deposits in Granitic and Syenitic Bodies

The zoned bodies of intrusive origin are fissure-filling pegmatite dykes that are usually lenticular, pod-shaped, or branching. The body is coarsely crystalline, the individual minerals being 1 ft. to 10 ft. or more in dimensions. The minerals are segregated into well-developed lithologic units from wall to core. Not all zones will necessarily be found in any one zoned dyke ; some may be absent. Two or more zones may merge along the strike or dip. Radioactive minerals are usually members of the complex multiple oxide groups and, rarely, uraninite. They may occur scattered irregularly or erratically throughout the dyke but are often confined to one lithologic unit or are found along the contact between two zones.

The MacDonald feldspar property is an example of this type. The uranium-bearing mineral is pyrochlore (ellsworthite). It occurred in the quartz core material, or with zircon masses at the contact between the wall and intermediate zones. The mineral was also present in a pod of salmon-pink calcite that occurred with the quartz core. It is possible that, in the mining for feldspar, radioactive minerals might be stockpiled, but in most occurrences of this type the radioactive minerals are too scarce to be of commercial interest.

In the Bancroft area the typical radioactive granitic body consists of a number of different lithologic units of both intrusive and replacement origins. The rock types of these units range in grain size from fine to coarse and in composition from granite to granite pegmatite. There is no well-defined zoning of the essential minerals into regular lithologic units. Bodies consist of one or more lithologic units: Granite, syenite, granite gneiss, granite (or syenite) pegmatite, quartz-rich granite pegmatite, magnetite-rich leucogranite or granite pegmatite, porphyroblastic granite pegmatite. If present in the granitic body units are irregular in size, shape, and position. These units show fairly sharp boundaries with one another across the strike but are often transitional along the strike or down the dip. The essential minerals are microcline, peristerite (albite with blue iridescent sheen), quartz, pyroxene, hornblende, and, rarely, biotite. The accessory minerals are allanite, zircon, titanite, apatite, fluorite, magnetite, hæmatite, calcite, pyrite, pyrrhotite, molybdenite and, rarely, anatase, melanocerite, bastnaesite, and umangite. The chief uranium accessory minerals are uraninite, uranothorite, thorite, pyrochlore (Bicroft), (Greyhawk), fergusonite (Rare Earth, Blue Rock), and the secondary uranium minerals uranophane, beta-uranophane, and kasolite. The chief lithologic units in which ore-bodies are found are : (1) Pyroxene granite (or syenite) pegmatite ; (2) leucogranite or leucogranite pegmatite with or without magnetite, and (3) cataclastic quartz-rich granite pegmatite. These ore-bodies may be at the foot-wall or hanging-wall or may occupy a medial position in the granitic bodies. Fractures or shear zones may play an important part in the localization of uranium mineralization, or in the emplacement of late-phase lithologic units. Uranium mineralization is usually accompanied by red discoloration of the feldspars and quartz of the granitic body. This hæmatitization is widespread but does not indicate necessarily that the mineralization is of ore grade. Hæmatitization of the feldspar in the country rock amphibolite or metagabbro was observed at a few of the properties. The development of pyroxene in the granite (or syenite) pegmatite can be seen to be intimately related to the assimilation of the wall rocks, especially amphibolite, as all stages may be observed from amphibolite inclusions, to relict bands, to crystals of pyroxene arranged in rows parallel to the walls of the granitic body, to scattered crystals or aggregates of pyroxene.

Metasomatic Deposits in Limy Rocks

Uranium-bearing zones in marble have been prospected and developed on 17 properties in the Bancroft area. Underground exploration has been

carried out at one property (Canadian All Metals). A comparison of these properties shows a remarkable similarity in the geology and mineralogy of the deposits. The host rock is a silicated marble, almost always with diopside, phlogopite, or occasionally tremolite as characterizing accessory minerals; serpentine was recorded once. A diopside rock is present, as well as marble, at four of the deposits. Accessory minerals include apatite, titanite, scapolite, dravite (Desmont), pyrite, pyrrhotite, and molybdenite. The uranium-bearing zones are irregular in size and shape and erratic in distribution within the marble host rock. They are marked by the presence at 12 out of the 17 properties of a salmon-pink calcite occurring in bands or lenses parallel to the banding in the marble. The radioactive minerals are: Uraninite (13 properties); uranothorite (8); pyrochlore (1), and thorite (1). The uraninite forms very small grains or minute cubes from $\frac{1}{40}$ in. or less to a maximum of $\frac{1}{4}$ in. The analyses available from the Bancroft area indicate that the thorium content is greater than 20% ThO_2 and therefore the mineral is thorian uraninite or thorianite (Normingo). When well crystallized it occurs frequently in interpenetration cube twins. Uranothorite occurs in small black grains or as laths and when uraninite is present it is often intimately associated with it. Thorite and uranothorite are found on the Kemp property, the thorite being in squat doubly-terminated tetragonal crystals. The distribution of these minerals is erratic. Work to date on these deposits has failed to outline uraniferous zones of sufficient size and grade to make ore-bodies.

Metamorphic pyroxenite bodies are found as lenticular metasomatic bodies in amphibolite and marble that have been intruded by syenitic or granitic bodies. These pyroxenite bodies range from small pods to bodies 500 ft. wide by 4,000 ft. long. They have been prospected for uranium on the Halo, Bicroft, and McLean-Hogan properties. The metamorphic pyroxenite is a rock composed essentially of a dark-green pyroxene, often with black mica as a characterizing accessory, and containing the following accessory minerals: Apatite, scapolite, titanite, purple fluorite, and uraninite. Small pods of salmon-pink calcite are often present. The uraninite occurs as rough grains, as cubes up to 1 in. across (Bicroft), and as octahedrons lining vugs (McLean-Hogan). The occurrence of uraninite appears to be controlled by: (1) The abundance of mica; (2) stringers or bands rich in scapolite, or (3) pyroxenite contacts with syenite or syenite pegmatite. The distribution is, however, erratic and despite the large size of some of the metamorphic pyroxenite bodies work to date has not been successful in outlining any ore-bodies.

Hydrothermal Deposits

Included here are the well-known uraninite-calcite-fluorite-apatite veins of the Wilberforce area and the betafite-calcite-apatite body of the Silver Crater property in Faraday township. The calcite veins are discontinuous, lenticular fissure fillings. They pinch and swell rapidly within short distances and range from a few inches to 12 ft. wide. Although many of the veins are of no great length, usually less than 50 ft., a few reach greater lengths, a maximum of 275 ft. being recorded on the Richardson property (Fission). The vertical extent is also limited as underground development at the Fission property has shown some veins pinching out at the adit level. Area mapping has not indicated that the veins follow any one fracture system, a variety of strikes and dips having been recorded. The veins sometimes contain significant amounts of hornblende, biotite, pyroxene, feldspar, scapolite, and magnetite. Accessory minerals include titanite, zircon, allanite, pyrite, pyrrhotite, molybdenite, uraninite, uranothorite or thorite, pyrochlore (ellsworthite) or betafite. The minerals hornblende, biotite, feldspar, apatite, titanite, and scapolite often occur as well-terminated crystals on the vein walls.

The calcite-fluorite-apatite-diopside-biotite veins at the Cardiff Uranium property are a special type and may not be fissure-fillings but possibly replacement bodies in a silicated marble horizon. A brief examination of the underground workings and the presence of diopside in the " vein material " suggest a replacement origin.

The close association at the Fission, Nu-Age, and Halo properties between pegmatite bodies and the veins and the spatial relationships of these indicates that the initial fissure was filled with syenite (or granite) pegmatite with accompanying metasomatic alteration of the wall rock. A fissure was then re-opened, wandering from wall to wall of the pegmatite body, and the emplacement of the vein followed.

It is interesting to note the occurrence of uranium-bearing minerals in these bodies. Some contain them and others, identical in appearance nearby, are completely barren. What controls the species of uranium-bearing mineral that occurs is not known. Similar veins contain at one locality only uraninite, at another uranothorite, and at a third betafite. Uraninite and uranothorite have been found together in the same vein. Betafite is the only uraniferous mineral in two calcite-fluorite-apatite veins on the Halo preperty and in the calcite-apatite-biotite body at the Silver Crater property. A striking case of dissimilarity is found on the Halo property, where a calcite-fluorite-apatite vein with betafite is adjoined 20 ft. away by a calcite-apatite-biotite vein with magnetite, no betafite, and no fluorite. These two veins have the same strike and dip. The veins often show a well-banded structure, dark-purple fluorite alternating with grey, to cream, to pale-pink calcite. Later movement along the fissure results in shearing, flowage of the calcite and fluorite vein material around crystals of apatite, hornblende, biotite, feldspar, or uraninite, or the incorporation of brecciated wall-rock fragments in the vein forming a mylonite breccia. The milling of the fluorite in extreme cases incorporates it with the calcite to produce an aphanitic or porcelainic mauve matrix to the other minerals and rock fragments (Fission) (Nu-Age). Although these sheared or mylonite zones are usually confined to the outer parts of a vein they sometimes cross from wall to wall in narrower veins (Fission).

The most striking wall-rock alteration adjacent to the calcite veins occurs when the wall rock is a syenite. This usually yellow-brown rock becomes a deep brick-red or purplish-red rock owing to hæmatitization. This is especially noticeable when uraninite crystals are found on the vein walls (Nu-Age). Possibly the colour of the apatite crystals is also indicative of hæmatitization at the wall zone, since deep brick-red crystals have been found lining a vein wall, whereas the crystals within a vein may be green (Nu-Age) (Halo).

(*To be concluded*)

Trade Paragraphs

British Geon, Ltd., of Devonshire House, Piccadilly, London, W. 1, announce that their telephone number is now Hyde Park 7321.

Edgar Allen and Co., Ltd., of Sheffield, have recently appointed Dr. A. D. Merriman, formerly Secretary of the Institution of Metallurgists, as consultant on scientific projects.

British Standards Institution, of 2, Park Street, London, W. 1, issue particulars of British Standards for winding and haulage ropes which are revisions of earlier standards, and also of wire ropes for excavators and cranes.

Bribond, Ltd., of Burgess Hill, Sussex, produce an extensive range of industrial and general signs which are designed to resist weather including extremes of temperature. Among the many examples given in an illustrated catalogue are several made for the National Coal Board.

Goodyear Tyre and Rubber Co., Ltd., of Wolverhampton, in the December issue of *Industrial Rubber News* draw attention to the increased range of their long length hose for water, air, and other fluids. For air all types are available in sizes from $\frac{3}{16}$ in. to $1\frac{1}{4}$ in. inside diameter.

W. G. Bagnall, Ltd., of Stafford, recently delivered the first of two diesel locomotives (308 h.p.) ordered by the N.C.B. to a colliery in the West Midlands Division. Each is capable of hauling over 1,400 tons, weighs 38 tons, is equipped with a four-speed gearbox, and has a fuel capacity of 250 gallons.

Vickers-Armstrongs, Ltd., of Vickers House, Broadway, Westminster, London, S.W. 1, recently sent a four-man team of technical experts on a tour embracing South Africa, Malaya, Australia, Tasmania, New Zealand, and Canada to visit overseas dealers and users of Vickers tractors and Vickers Onions equipment for earth moving.

Consolidated Pneumatic Tool Co., Ltd., of 232, Dawes Road, London, S.W. 6, are to produce a full range of pneumatic tools including rock-drills and air-compressors and pumps in India and announce that a new factory for the purpose at Muland on the outskirts of Bombay is expected to be completed about the middle of this year. It will be operated by a subsidiary company registered in India.

BTR Industries, Ltd., of Herga House, Vincent Square, London, S.W. 1, announce that Oil Feed Engineering Co., Ltd., of 18, Denbigh Street, Victoria, London, S.W. 1, for many years manufacturers of high-pressure flexible hose assemblies under the " Hi-Flex " trade mark, has now become a member of the BTR group and will operate as the high-pressure hose division of the group.

George Kent, Ltd., of Luton, announce that their Mark 2A electronic Multilec recorder is now generally available to industry. They also draw attention to their Commander KE range of high-speed electronic instruments. Among applications are pH recording and controlling, for which purposes instruments are in use in Canada, Australia, and Malaya and in other sections of the mining industry.

British Ropes, Ltd., of Doncaster, state that Mr. E. D. Nicholson, secretary, and Mr. A. S. Watts, southern area manager, of the company have just returned from Mexico where they carried through negotiations to form a new company which will shortly commence the manufacture of steel wire ropes in Mexico City. The new company, Cables Mexicanos S.A. de C.V., will have as its general manager Mr. J. M. Downton, who has until recently been ropery manager at their Retford plant.

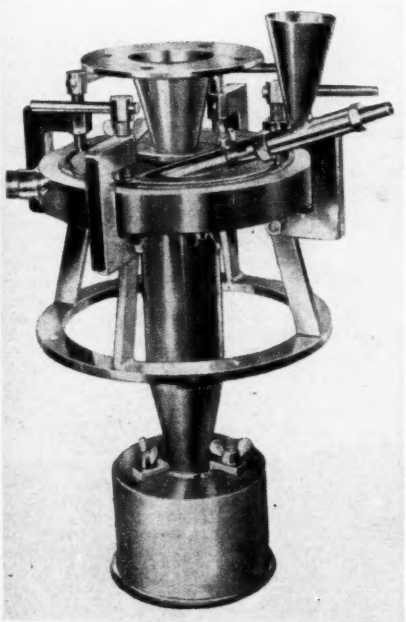
Meynell and Sons, Ltd., of Montrose Street, Wolverhampton, have introduced a stop-valve of new design suitable for controlling the flow of almost any liquid and gas up to a maximum temperature of 100° C. Described as the Rayon-Patent the upper part of the rubber valve is so shaped that the movable parts of the valve remain isolated from the fluid, so eliminating the need for packing glands, it is stated. The body is supplied screwed or flanged in cast iron, malleable iron, bronze, or aluminium.

Associated Lead Manufacturers, Ltd., of Clements House, 14, Gresham Street, London, E.C. 2, last month afforded an opportunity of seeing a colour film featuring " Rustodian," the rust-inhibiting calcium plumbate paint they manufacture. The film, by means of an animated diagrammatic sequence, is used to explain in simple terms the theory of the electrical origins of corrosion and then goes on to show how calcium plumbate pigment was thoroughly evaluated and how Associated Lead—who had sponsored the research—put it into commercial production and marketed it under the trade name of " Caldiox." Some of the processes of manufacture are shown. The film then shows the manufacture of Rustodian, using Caldiox pigment and stresses the remarkable qualities of adhesion of this new paint which have made it an invaluable primer for most metals and—most important of all—for new unetched galvanizing.

Borax Consolidated, Ltd., of Borax House, Carlisle Place, London, S.W. 1, state that a comprehensive range of metallic borides is now available in this country, the company being now able to supply two series of borides, one of high chemical purity (not less than 99·8%) and the other comprising technical grades of minimum purity of the order of 99%. Several borides of the more important metals such as chromium, molybdenum, and tungsten appear either in one or both of the ranges as well as the borides of some of the less common metals such as titanium, zirconium, vanadium, niobium, and tantalum. The high melting points of metallic borides (up to 3,100° C.), and their hardness, make them compounds of major metallurgical interest. Their corrosion resistance, both to noxious gases and to liquid or gaseous metals, has stimulated research into the possibilities of their use in gas turbines and other locations where their inert character is of importance. Many research organizations are investigating fabrication techniques, both from the point of view of pressing by powder metallurgy techniques and of forming coatings on metals or alloys. The part they play in " cermets "—the new series of metal-ceramic compounds—is well known and they may also be of use in tools and dies. Zinc, aluminium, and uranium concerns are taking an interest and as development work progresses their unique properties will find for them an ever-increasing range of applications, the statement says. The 11 compounds in the pure series are dense

hard powders of average particle size of 10–50 microns and the 14 in the technical series are finer, averaging 5–10 microns in particle size. Two technical data sheets—one for each series—have been published. These list the chemical analysis, specific gravity, melting point, and hardness of each compound. The electrical conductivities, which are of some importance in certain applications, are also included.

F. W. Berk and Co., Ltd., of 1–19, New Oxford Street, London, W.C. 1, issue a leaflet in English, German, French, and Spanish which describes and illustrates the Micronizer mill. The mill, which is shown here, is intended for producing powders of sub-sieve dimensions and is capable of producing materials whose average particle size is 5 microns (2,500 theoretical mesh). Reduction in particle size is effected by the material grinding upon itself and the energy required to set up the inter-particle attrition is supplied by any compressed gas—usually air or steam. It is easily dismantled and cleaned and by simple change of components it can be readily adapted for any of its functions. Materials that can be successfully processed include metallic and non-metallic minerals, ores, and some metal powders. Under certain conditions it is possible to reduce hard abrasive materials (Moh's scale 8) to sizes of less than 5 microns. The material to be ground is injected into the flat cylindrical grinding chamber by either a venturi feeder or a motor-driven screw conveyor. The compressed gas is expanded into the chamber through a series of jet nozzles spaced around the inside diameter of the chamber. These jets maintain a high speed of rotation in the grinding chamber. Solids fed into the grinding chamber are accelerated by the rotating gas and are thrown to the periphery where a portion coming into the zone of the nozzles is further accelerated tangentially and radially inwards, causing violent impacts between the particles thus accelerated and the other particles circulating at a much slower velocity in the thin band near the periphery. The fines resulting from the continuous series of impacts are collected by the rotating gas and conveyed in an inwards-spiralling path towards the central outlet. The fine particles approaching the outlet are subjected to an intense classifying action by centrifugal force which returns the oversize particles to the grinding zone and the force of the exhausted gas carries the finer particles to the outlet. The collection of the fines is accomplished by passing the exhaust gas through a cyclone-type collector which can be an integral part of the Micronizer or separate. By the preservation of the rotational speed of the exhaust air entrained solids a high degree of collection efficiency is obtained on the cyclone collector. The exhaust gas is then passed to a bag filter and in the case of steam to a condenser, where the very small quantity of entrained solids left in the gas is extracted.



Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, announce that two orders covering four 2,500-h.p. electric winders were recently placed by the North-Western Division of the National Coal Board. They are of particular interest because they form an important part of the Board's plan to exploit Lancashire coal reserves previously regarded as unobtainable. Two of the winders will be installed at Agecroft Colliery, which is being re-opened and modernized; the other two are for a new mine, the first in Lancashire for over 30 years, which is being sunk at Parkside, near St. Helens. Both collieries will together eventually produce over 2,000,000 tons of coal a year. The new winders will be of the four-rope tower-mounted friction type and will be driven by d.c. motors supplied from mercury-arc converters. The converters are used as rectifiers and inverters—a system which has been developed by the company and which was first used on the 300-h.p. winder installed early in 1955 at Monk Bretton Colliery in the North-Eastern Division. The operation of the Monk Bretton installation over the past three years has shown this system to be technically successful and economically advantageous. The use of static equipment reduces maintenance costs, running costs, and building expenses. As a result the N.C.B. has adopted the system for other winders which are now in hand for the Peckfield, Silverhill, Ellistown, and Dawdon Collieries. The adoption of mercury-arc converters for such large winders as those for Agecroft and Parkside means that this system of winder control is now definitely established. Each of the 2,500-h.p. 700-volt d.c. winder motors will obtain its supply from a bank of four pumpless steel-tank rectifier units with a grid control unit for the whole bank. The rectifiers will be supplied from transformers each consisting of two 12-phase units connected together to give 24-phase operation and to reduce harmonic distortion on the 11 kV mains supply. The transformers will be immersed in a non-inflammable coolant. At each colliery one winder will operate with a skip and counterweight and the other with a cage and counterweight. The skip winder will be used mainly for hoisting coal from a number of horizons and will be automatically

operated under the control of the banksman. The cages will carry men and materials and the winders for them will be manually operated, having a closed-loop control system. The mechanical equipment for each winder will be manufactured by **Vickers-Armstrongs (Engineers), Ltd.,** and will consist of a four-rope friction wheel, 12 ft. in diameter, driven through single-reduction double-helical gears supplied by **Turbine Gears, Ltd.**

English Electric Activities, 1957
Mining Division

The main trend of the contracts received during 1957 by the English Electric Co., Ltd.'s, mining division has been the increase in the number of equipments ordered for modernizing existing installations both in the United Kingdom and overseas. While most such modernization orders cover the whole of the electrical parts, some are for partial equipments only, to enable the winder to comply with present-day regulations.

Most of the orders placed by the National Coal Board comprise geared a.c. equipments, having orthodox manual control, with ground-mounted single or double drums. Six of the a.c. winders will, however, be fitted with manual supervisory closed-loop control; the R.M.S. ratings of these six equipments vary between 800 h.p. and 1,800 h.p. On some of the orders for the N.C.B.—in addition to providing the winder electrical and mechanical equipment as part of the contract—the company will also supply the main transformer, main switchgear, air-compressor, and ventilating fan equipment.

Orders for overseas countries included equipments for Canada and South Africa. Typical orders for Canada covered the complete electrical parts for geared Ward-Leonard winders, one for 700 h.p. and another for 450 h.p., each with closed-loop control. The larger of these winders is a multi-level skip winder arranged for push-button automatic control. Included among the orders for South Africa were a 3,000-h.p. twin motor geared a.c. winder and an 850-h.p. geared a.c. winder. Other contracts covered the addition of dynamic braking to existing winders.

Several winders were commissioned during the year, the most notable of these being the first tower-type multi-rope friction Ward-Leonard skip winder in Great Britain, this being the largest friction winder of any type in this country. The combined rating of the twin winder motors is 3,950 h.p. The second of three 2,000-h.p. 73-r.p.m. single-motor overhung tower-type multi-rope friction winders was also commissioned. This multi-level cage and counterweight winder is operated by pushbutton automatic control for both coal and stone winding. Under manual control the winder is controlled from a desk mounted at pit top, but manual control from the tower is also available. The first winder of this type was commissioned in September, 1956, and the third is in course of installation.

Apart from the two tower-type Ward-Leonard multi-rope friction winders commissioned this year the first tower-type multi-rope geared a.c. friction winder has been put into commercial service in this country. The R.M.S. rating of the winder motor is 500 h.p.

Among overseas commissionings were a twin motor 4,040 h.p. geared a.c. winder in South Africa and a 1,425 h.p. geared a.c. winder in Southern Rhodesia.

Review of G.E.C. Activities in 1957

As usual at this time of a year the General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C. 2, have produced some brief notes under the above heading, from which extracts follow :—

Winding Engines.—Among the winding engines installed overseas during the past year, are two interesting machines in Australia—one at Cessnock Colliery, New South Wales, and the other at Mount Isa Mines. The Cessnock winder has a single drum, 14 ft. diameter by 10 ft. 6 in. wide, directly driven by a 1,450-h.p. d.c. motor, and is designed for a coal-raising duty of 7,616 lb. from a depth of 1,270 ft. The drum has cast-iron cheeks and the drum shell is of welded construction. The shell stiffeners are completely welded to the shellplate and the whole is normalized before final machining.

The Mount Isa Mines unit is the largest electric winder ever to be installed at an Australian mine. It is a 16 ft. diameter by 6 ft. double-drum double-clutched winder driven through single-reduction gearing by two 2,260-h.p. d.c. motors and is designed to deliver 180,000 tons of ore from mine to mill each 28-day period, this being an increase of almost 80,000 tons over the present shaft capacity. Automatic push-button control from twelve levels is a feature of this installation.

A 4-rope Koepe winder, one of the largest of its type, was installed during 1957 at the Driefontein Gold Mine near Johannesburg. With the exception of the gears the mechanical parts were made by the East Rand Engineering Co., Ltd., from drawings and design data supplied by Fraser and Chalmers Engineering Works. It is capable of raising a skip load of 14 short tons from a depth of 5,460 ft. All the electrical equipment was made at Witton; it includes two 2,050-h.p. d.c. motors and a 3,800-h.p. Ward Leonard set operating in conjunction with control exciters. Notable features of the control gear supplied by Witton include provision for push-button control by the onsetter at the bank, in addition to normal hand control by the winding driver, and also the use of geared potentiometers and induction regulators.

Switchgear.—An addition to the G.E.C. range of line-trap coils for use in conjunction with telemetering equipment on high-voltage lines is a 2,000-A coil developed to fulfil an order from the Aluminium Company of Canada for the Kitimat-Kemano project. This line-trap is the largest in the range, which now comprises coils rated at 400, 600, 800, 1,200, 1,600, and 2,000 A, all with an inductance of 200 microhenries.

Materials Handling.—For the Indian Government's new steelworks at Durgapur, near Calcutta, the materials handling department of the Fraser and Chalmers Engineering Works has received orders comprising the complete ore handling and blending plant, which is designed for dealing with limestone, dolomite, and miscellaneous materials. The plant includes three wagon tipplers, each of 40 tons gross capacity, for discharging the ore and limestone to the conveyor system, which is some four miles in length, while the ore blending section comprises two stackers and two Robins Messiter reclaiming machines. In addition to this plant further orders are in hand for three stackers and three similar blending machines, together with two further wagon tipplers for the coal blending section, providing coking coal for the blast-furnaces.

Annual Review of BTH Progress

British Thomson-Houston Co., Ltd., of Rugby, issue their usual report from which extracts follow :—

Mine Winders.—Several important mine winders were installed and commissioned during 1957. The most notable of these is perhaps the 2,500-h.p. twin-rope friction winder installed at Hem Heath Colliery. The equipment has a payload of 10 tons and is designed for an output of 235 tons per hour from a depth of 3,360 ft. In Scotland two more closed-loop a.c. winders were commissioned at Barony colliery and Polkemmet. Both winders are equipped with rotor contactor gear used in conjunction with forced-ventilated type RP metallic resistances for controlling the speed of the winder motors. At Coegnant colliery, in South Wales, the third 1,000-h.p. a.c. winder to be installed in that area recently was commissioned during last August. Several smaller winders were commissioned, including two more 700-h.p. double-drum sinking winders at Parkside colliery. Work is proceeding on the erection of the 1,250-h.p. tower-mounted four-rope friction winder for the service shaft at Killoch colliery in Scotland. The electrical equipment for this winder was ordered by the National Coal Board through **Fullerton, Hodgart and Barclay, Ltd.,** as main contractors. and includes closed-loop control with dynamic braking, the speed being controlled in this case by a liquid controller. Another tower-mounted a.c. winder is being erected in Scotland at Bedlay colliery. This is rated at 1,000-h.p. and includes a BTH main reduction gearbox. The first of nine mobile emergency winder equipments, for which BTH received the contract for the electrical portion through **Walker Brothers (Wigan), Ltd.,** has been erected and commissioned. Five more equipments are at present being erected and will be commissioned early in 1958.

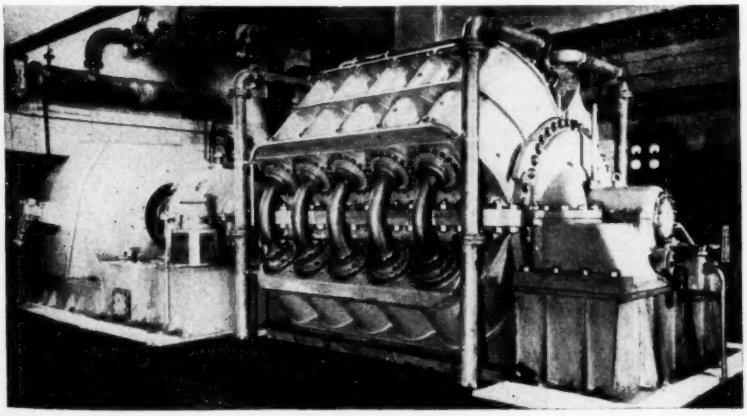
Several important winder orders were received during the year. Amongst these were four destined for Kellingley colliery, in Yorkshire, two of them each being driven by a single motor rated at 1,100-h.p. to operate at 11,000 volts, while the other two are twin-motor driven, each motor also being rated 1,100-h.p. These winders are for tower mounting, the two single motors being installed in one tower and the two twin motors in another. A 500-h.p. drum winder for Marquis colliery in Leicestershire will be a general purpose machine of the conventional a.c. type with dynamic braking, its main function being to raise and lower men at the start and finish of each shift and also for handling materials. The mechanical portion of these winders has been sub-contracted to **M. B. Wild and Co., Ltd.** A 1,200-h.p. Ward-Leonard equipment ordered for Grimethorpe colliery in Yorkshire is a four-rope tower-mounted Ward-Leonard friction unit, the motor-generator set of which is driven by a 1,350-h.p. induction motor operating at 11,000 volts, the generator being rated 900 kW. The mechanical portion for this winder has been sub-contracted to **Fraser and Chalmers Engineering Works.**

General Mining Equipment.—During the year several large a.c. motors have been commissioned, including two further 1,330-h.p. synchronous type AGT for driving compressors, two further 805-h.p. synchronous induction motors for compressors, one 775-h.p. synchronous induction motor for a compressor, one 700-h.p. synchronous induction motor for a fan drive, and two 1,100-h.p. synchronous induction motors for fan drives. In addition orders have been received for one 1,313-h.p., one 895-h.p., and one 1,330-h.p. synchronous motors for driving compressors and one 1,500-h.p. synchronous induction motor for a fan drive.

An interesting 250-h.p. haulage is in hand for Wernos colliery in the S.W. Division. There are ten steps of rotor resistance control, the first five being manually operated, the remainder automatic, controlled by the stator current of the motor *via* a current transformer. Varithrust braking equipment, for which there continues to be a steady demand, is also included for this haulage.

Several important switchgear contracts were completed during the year. These include two 9-panel and one 4-panel QA 6·6-kV switchboards having a breaking capacity of 150 MVA for Killoch colliery. At Thoresby colliery an 11-kV, 250-MVA, 5-panel QF board has been installed to extend the existing board, as well as additions to the 2·2-kV existing board which consists of Class QA switchgear rated at 75 MVA. At Cannock Wood and Lea Hall collieries 26 QA switch panels have been installed.

In the mine car handling field one of the most interesting projects at present in hand is the surface handling scheme for use in association with the automatic friction winder at Cynheidre colliery.



Centrifugal Compressor at Markham Main Colliery.

Other schemes commissioned and/or put in hand during the last year are 22 duplicate sets of electrical equipment for surface decking rams, supplied to **Hudswell, Clarke and Co., Ltd.,** for use in the N.C.B. North Eastern Division. In addition two similar sets of Buxton-certified flameproof equipment have been supplied for use underground. One other scheme at present in hand for **Plowright Brothers, Ltd.,** for Ekulu mine, Nigeria, provides for a continuous stream of mine cars to pass through a ramming, weighing, ramming, and tippling sequence at the rate of 200 cars per hour.

Communication Equipment.—BTH Clearcall equipment has now been developed for use on closed-circuit mine car schemes. It is used instead of telephones and has the advantage that it is brought into action by a foot-operated push-button, thus leaving the operator's hand free for the car circuit controls. Sound is transmitted by carrier-frequency which can be injected into conductors such as an existing telephone communication or supply cables which are already available. The Portavox mine telephone amplifier has now been developed and the necessary flameproof and intrinsic safety certificates obtained. The equipment is additional to the mine telephone and amplifies the signals normally reproduced by the telephone ear-piece so that they are heard through a loudspeaker.

Excavators.—During the past year Ward-Leonard equipment has been in great demand for excavators and **Ruston-Bucyrus** 110-RB excavators fitted with BTH electrical equipment are in operation in Finland, Sweden, Holland, France, Turkey, India, and Australia. The second W 1400 giant dragline, supplied by **Ransomes and Rapier, Ltd.,** to United Steel Companies, Ltd. and fitted with BTH electrics, went into operation in September, 1957.

Transformers.—At Baie Comeau, near Quebec, eight rectifier transformers of the 16 to be supplied have now been commissioned at the new aluminium smelter of the Canadian British Aluminium Co., Ltd. The transformers, which are rated for a rectifier output of 12,100 kW 850 volts d.c., are probably the largest in the world for this duty.

At the Owen Falls Station of the Uganda Electricity Board the erection of the seventh and eighth, 16,500-kVA, 150-r.p.m. generators is proceeding according to programme and it is hoped to commission these two units during 1958.

Large Motors.—Repeat orders have been received from some of the South African gold mines for synchronous and induction motors for driving pumps.

RECENT PATENTS PUBLISHED

☛A copy of the specification of the patents mentioned in this column can be obtained by sending 2s. 8d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

24,484 of 1954 (788,542). KNAPSACK-GRIESHEIM A.-G. Comminution process and apparatus.

34,171 of 1954 (788,940). WESTINGHOUSE ELECTRIC INTERNATIONAL CO. Electrostatic precipitators.

11,837 of 1955 (789,127). SIMON-CARVES, LTD. Coal or ore washing plant.

24,094 of 1955 (789,398). IMPERIAL CHEMICAL INDUSTRIES, LTD. Manufacture of titanium.

32,645 of 1955 (789,552). FAB. DE PRODUITS CHEMIQUES DE THANN ET DE MULHOUSE. Recovery of titanium tetrachloride from chlorination gases.

35,773 of 1955 (788,826). KLÖCKNER-HUMBOLDT-DEUTZ A.-G. Heating fine solid granular material.

11,821 of 1956 (789,497). FARBENFABRIKEN BAYER A.-G. Process for the decomposition of titanium ore.

13,168 of 1956 (788,525). SOC. MIN. ET METALLURGIQUE DE PENARROYA. Recovery of zinc crust obtained in the separation of silver from lead.

16,021 of 1956 (788,706). SOC. D'ELECTRO-CHIMIE, D'ELECTRO-METALLURGIE, ET DES ACIERIES ELECTRIQUES D'UGINE. Separation of nickel.

NEW BOOKS, PAMPHLETS, ETC.

☛Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine* 482, Salisbury House, London, E.C. 2.

Geologic Field Methods. By JULIAN W. LOW. Cloth, octavo, 489 pages, illustrated. Price 48s. New York: Harper and Brothers.

The Milling of Canadian Ores (6th Commonwealth Mining and Metallurgical Congress, 1957). Cloth, quarto, 447 pages, illustrated. Price 100s. Vancouver: Commonwealth Congress.

Structural Geology of Canadian Ore Deposits—II (6th Commonwealth Mining and Metallurgical Congress). Cloth, octavo, 524 pages, illustrated. Price 100s. Vancouver: Commonwealth Congress.

Notes on the Geology of Uranium: U.S. Geological Survey Bulletin 1046—F. By M. R. KLEEPER and D. G. WYANT. Paper covers, pp. 87–148. Price 25 cents. Washington: Superintendent of Documents.

Geologic Names of North America Introduced in 1936–1955: U.S. Geological Survey Bulletin 1056—A. Paper covers, 405 pages. Price $1·00. Washington: Superintendent of Documents.

Kenya: Geology of the Takabba-Wergudud Area, Mandera District. By E. P. SAGGERSON and J. M. MILLER. Geological Survey Report No. 40. Paper covers, 42 pages, illustrated, with maps. Price Sh. 15/-. Nairobi: Government Printer.

Ghana: Geological Survey Report, 1955–56. Paper folio, 13 pages. Price 2s. London: Crown Agents for Oversea Governments and Administrations.

Mineral Commodities of California: Division of Mines Bulletin 176. Edited by L. A. WRIGHT. Cloth, quarto, 736 pages, illustrated. Price $7·50. San Francisco: Department of Natural Resources.

Fiji: Annual Report on Mining, 1956. Paper folio, 25 pages, illustrated, with map. Price 2s. Suva: Department of Lands, Mines, and Surveys.

The Engineer Buyers Guide, 1958. Paper covers, 888 pages. Price 7s. 6d. London: The Engineer Buyers Guide.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE. † Article digested in the MAGAZINE.

Economics

Coal, United Kingdom : *Gasification, Underground.* Underground Gasification of Coal. *Coll. Engg.*, Feb., 1958.

***Mining, Canada :** *Tours, Congress.* Congress in Canada. J. A'C. BERGNE, THE MINING MAGAZINE, Jan., Feb., 1958.

***Production, Africa :** *Gold, Ethiopia.* Alluvial Goldfield in Ethiopia. H. L. HOLLOWAY, THE MINING MAGAZINE, Feb., 1958.

Production, Canada : *Asbestos, Review.* The Asbestos Industry. *Precambrian*, Dec., 1957.

Production, India : *Industry, Aluminium.* The Aluminium Industry in India. A. DAS GUPTA, *Ind. Minerals*, Apr.–June, 1957.

Production, United Kingdom : *Coal, 1957.* Statistics Relating to Mechanized Output (Third Quarter, 1957). *Inform. Bull. N.C.B.* No. 58/194.

Production, United States : *Columbite, Idaho.* Idaho Placer is Source of 99% of U.S. Columbium-Tantalum Output. *Min. World* (San Francisco), Jan., 1958.

Production, United States : *Fluorspar, Illinois* Fluorspar Mining in Hardin County, Illinois. *Min. Engg.*, Jan., 1958.

†Research, Thermonuclear : *Progress, Aldermaston.* Progress in Thermonuclear Research at Associated Electrical Industries, Ltd. THE MINING MAGAZINE, Feb., 1958.

†Resources, Australia : *Platinum, Review.* Platinum Group Metals. *Summ. Rept.* No. 39, Commonwealth Bur. Min. Res.

Resources, United States : *Pyrophyllite, N. Carolina.* Resources and Utilization of North Carolina Pyrophyllite. J. L. STUCKEY, *Min. Engg.*, Jan., 1957.

Taxation, Mine : *Review, United States.* Income Tax Treatment of Development and Exploration. H. B. FERNALD, *Min. Engg.*, Jan., 1958.

Geology

†Economic, Canada : *Uranium, Ontario.* Radioactive Mineral Occurrences in the Bancroft Area. J. SATTERLY, 65th Ann. Report Ont. Dept. Mines.

Economic, India : *Limestone, Ajmer.* The Limestone Deposits of Ajmer State. B. C. ROY, *Ind. Minerals*, Apr.–June, 1957.

Economic, Mexico : *Mineral, North-Eastern.* Mineralized Cretaceous Horizons in North-Eastern Mexico. P. SANCHEZ-MEJORADA, *Min. Engg.*, Jan., 1958.

Economic, Peru : *Copper, Cuajone.* Porphyry Copper Deposit, Cuajone, Peru. W. C. LACY, *Min. Engg.*, Jan., 1958.

Economic, United States : *Uranium, Asphaltic.* Reconnaissance for Uranium in Asphalt-Bearing Rocks in the Western United States. W. J. HAIL, *U.S. Geol. Surv. Bull.* 1046-E.

Exploration, Drilling : *Coal, United Kingdom.* Off-Shore Boring. W. S. DRYSDALE, *Trans. Instn. Min. Eng.*, Jan., 1958.

Regional, Africa : *Kenya, Southern.* Geology of the Kalossa–Tiati Area (Degree Sheet 26). P. MASON, A. B. GIBSON, Ken. Geol. Surv. Report No. 41.

Regional, South Africa : *Soutpansberg, Low Veld.* The Geology of the Eastern Soutpansberg and the Lowveld to the North (Sheet 42). O. R. VAN EEDEN and others, S.A. Geol. Surv. Memoir.

Sampling, Statistical : *Deposits, Mineral.* The Problem of Sampling Mineral Deposits. F. FALINI, translation of an original article published in *L'Industria Mineraria*, Rome, Aug.–Sept., 1956.

Survey, Geochemical : *Tests, Spectrographic.* Spectrographic Laboratory. W. J. BICHAN, *Canad. Min. J.*, Jan., 1958.

Survey, Geophysics : *Discovery, Canada.* Case History of the Juniper Prospect. S. H. WARD, R. A. BARKER, *Min. Engg.*, Jan., 1958.

Metallurgy

Engineering, Nuclear : *Role, Metallurgy.* The Role of Metallurgy in Atomic Energy Technology—I. A. BLAINEY, *J. S. Afr. Inst. Min. Metall.*, Dec., 1957.

Handling, Iron-Ore : *Equipment, United Kingdom.* Iron-Ore Handling and Preparation : Use of Conveyors at East Moors Works of Guest, Keen Iron and Steel Co., Ltd. T. H. KEEN, *Iron, Coal Tr. Rev.*, Jan. 24, 1958.

Iron, Titaniferous : *Process, Smelting.* The Halverson Process. *Precambrian*, Dec., 1957.

Metals, Fatigue : *Failures, Equipment.* Fatigue in Mining and Construction Equipment. B. M. HAMILTON, *Canad. Min. Metall. Bull.*, Dec., 1957.

Metals, Fatigue : *Study, Canada.* The Mechanism of Fatigue : A Review. R. C. A. THURSTON, *Canad. Min. Metall. Bull.*, Dec., 1957.

***Slags, Treatment :** *Tin, Tungsten.* Treatment of Tin Slags. C. W. JENSEN, THE MINING MAGAZINE, Feb., 1958.

Steel, France : *Ore, Sintered.* Blast-Furnace Practice at the Soc. Métall. de Knutange ; Effect of Charging Sinter. M. BRUN, *Iron, Coal Tr. Rev.*, Jan. 28, 1958.

Machines, Materials

Drill, Rotary : *Type, Dry.* New Rotary Drill Developed in America. *Chem. Engg. Min. Rev.* (Melbourne), Dec. 16, 1957.

Equipment, Rescue : *Approved, United States.* Auxiliary and Supplemental Mine Rescue Equipment. W. D. WALKER and others, *Inform. Circ. U.S. Bur. Min.* 7808.

Loader, Mine : *Device, Pneumatic.* Pneumatic Ore Loading Machine Developed in Sardinia. *Chem. Engg. Min. Rev.* (Melbourne), Dec. 16, 1957.

Steel, Drill : *Developments, Swedish.* Advance in the Development of Drill Rods in Sweden. J. A. PERHAM, *Canad. Min. J.*, Jan., 1958.

Tester, Detonator : *Ohmmeter, Safe.* A Safe Detonator-Testing Ohmmeter. W. G. MOFFAT, *Bull. Instn. Min. Metall.*, Feb., 1958.

Tools, Drilling : *Rotary, Design.* The Design of Rotary Drilling Tools—3. B. G. FISH, J. S. BARKER, *Coll. Engg.*, Feb., 1958.

Mining

Alluvial, Dredging : *Columbite, United States.* Idaho Placer is Source of 99% U.S. Columbium-Tantalum Output. *Min. World* (San Francisco), Jan., 1958.

***Alluvial, Dredging :** *Gold, Ethiopia.* Alluvial Goldfield in Ethiopia. H. L. HOLLOWAY, THE MINING MAGAZINE, Feb., 1954.

†**Asbestos, Canada :** *Hazard, Wood.* Eliminating Wood in Asbestos Mining. R. GUIMOND, *Precambrian*, Dec., 1957.

Coal, United Kingdom : *Problem, Dirt.* The Dirt Problem in British Coal Mines, with Particular Reference to the North-Eastern Division. J. V. GREENSMITH, *Trans. Instn. Min. Eng.*, Feb., 1958.

General, United Kingdom : *Iron, Lincolnshire.* The Dragonby Mine. *Mine, Quarry Engg.*, Jan., Feb., 1958.

General, United States : *Iron, Michigan.* Tracy Mine of Jones and Laughlin Steel Corporation. R. W. BRAUND, *Min. Engg.*, Jan., 1958.

Handling, Conveyor : *Installation, United States.* Remote-Controlled Shuttle Conveyor Serves Five Discharge Points. *Engg. Min. J.*, Jan., 1958.

Handling, Haulage : *Coal, United Kingdom.* The Economics of Main Road Haulage. J. C. R. CLAPHAM, *Trans. Instn. Min. Eng.*, Feb., 1958.

Handling, Iron-Ore : *Chutes, Rubber.* Kiruna Proves It Takes a Lot of Hard, Sharp, Heavy Iron Ore to Wear Out Rubber Chutes. A. W. KJELGAARD, *Min. World* (San Francisco), Jan., 1958.

Hygiene, Silicosis : *Dust, Airborne.* On the Size Distribution of Airborne Mine Dust. H. S. SICHEL, *J. S. Afr. Inst. Min. Metall.*, Dec., 1957.

Hygiene, Silicosis : *Dust, Control.* The Mixing of Respirable Dust with the Mine Ventilation Studied by a Radio-Active Tracer Technique. J. R. HODKINSON, *Trans. Instn. Min. Eng.*, Jan., 1958.

Hygiene, Ventilation : *Flow, Heat.* Heat Flow into a New Main Roadway. J. A. HITCHCOCK, C. JONES, *Coll. Engg.*, Feb., 1958.

Movements, Ground : *Control, Study.* Surface and Underground Subsidence Correlation. D. TURNBULL, E. L. J. POTTS, *Coll. Engg.*, Feb., 1958.

Open-Cast, Quarrying : *Holes, Blasting.* The Use of Large-Diameter Drill Holes in Quarrying. A. HEIDRICH, *Mine, Quarry Engg.*, Jan., Feb., 1958.

Power, Electric : *Use, Underground.* Use of A.-C. Power on Conventional Mining Sections. C. S. CONRAD, *Min. Engg.*, Jan., 1958.

Pressures, Rock : *Study, Instruments.* Instrumentation for Rock Pressure Research. D. JACOBI, *Coll. Engg.*, Feb., 1958.

Tailings, Dredging : *Iron, United States.* J. and L. Dredges Iron-Ore Tailings for New Spiral-Flotation Plant. H. L. WALDRON, *Min. World* (San Francisco), Jan., 1958.

Ore-Dressing

Cleaning, Coal : *Systems, Review.* Coal Preparation Practice : Comparison of Systems. A. E. WHITTLE, *Iron, Coal Tr. Rev.*, Jan. 24, 1958.

Flotation, Iron : *Plant, United States.* Flotation Starts on the Mesabi. R. W. LIVINGSTONE, *Engg. Min. J.*, Jan., 1958.

***Flotation, Research :** *Pick-Up, Bubble.* Modified Bubble-Pick. Ore-Dressing Notes, THE MINING MAGAZINE, Feb., 1958.

General, Greece : *Lead-Zinc, Chalkidiki.* Kassandra Mines. L. MOUSSOLOS, *Deco Trefoil*, Nov.–Dec., 1957.

General, Iron : *Concentration, Dry.* Dry Concentration of Iron Ore. *Engg. Min. J.*, Jan., 1958.

Gravity, Cyclone : *Capacity, Formula.* A Simple Formula for Calculating the Approximate Capacity of a Hydrocyclone. I. R. M. CHASTON, *Bull. Instn. Min. Metall.*, Feb., 1958.

Spirals, Use : *Development, Review.* The Humphreys Spiral Concentrator : Its Place in Ore Dressing. J. V. THOMPSON, *Min. Engg.*, Jan., 1958.

ngdom. The
J. C. R.
b., 1958.

er. Kiruna
Heavy Iron
KJELGAARD,
3.

On the Size
H. S. SICHEL,
7.

he Mixing of
tion Studied
ue. J. R.
an., 1958.

Heat Flow
HITCHCOCK,

. Surface and
D. TURNBULL,

ing. The Use
Quarrying,
n., Feb., 1958.

Use of A.-C.
tions. C. S.

ents. Instru-
n. D. JACOBI,

ates. J. and L.
piral-Flotation
an Francisco),

y. Coal Pre-
ystems. A. E.
4, 1958.

ates. Flotation
GSTONE, *Engg.*

bble. Modified
THE MINING

idiki. Kassan-
oil, Nov.–Dec.,

vy. Dry Con-
., Jan., 1958.

ula. A Simple
imate Capacity
ON, *Bull. Instn.*

Review. The
ts Place in Ore
gg., Jan., 1958.